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Heating Piping & Air Conditioning

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INDUSTRIAL
COMMERCIAL
AND LARGE
BUILDINGS

Page 85 — *Journal Section of the American Society of Heating and Ventilating Engineers*

A market scene in Mexico. Don't miss F. W. Hutchinson's entertaining story of the "background for research", on page 65

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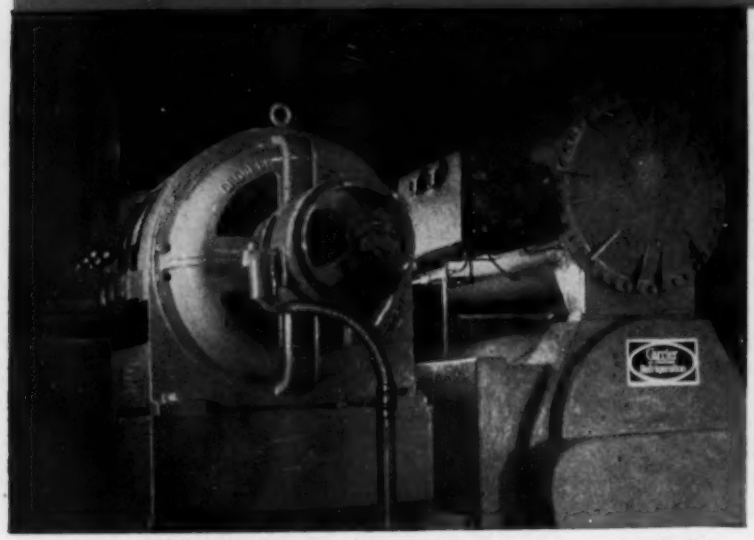
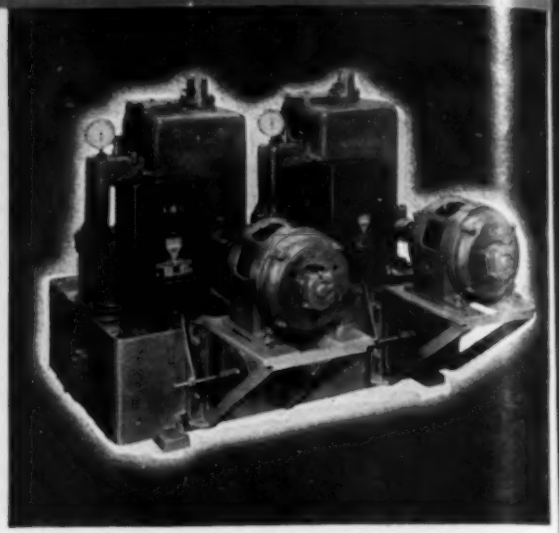
CROCKER-WHEELER POWER for AIR-CONDITIONING EFFICIENCY



One of two 600 ton centrifugal air-conditioning units powered with 500 h.p. Crocker-Wheeler synchronous motors in one of Washington's leading hotels.



C-W motors powering Chicago Pump Company return line vacuum and boiler feed pumps for continuous duty.

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TODAY you will find thousands of Crocker-Wheeler motors driving all types of air-conditioning, refrigeration, heating and ventilating equipment in war industries . . . rendering the same dependable service that has established the Crocker-Wheeler name for quality equipment of liberal design in squirrel cage motors, wound rotor motors, synchronous motors and direct current motors.

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THE EDITOR'S PAGES

"FACTUAL, CLEAR, AND . . . USEFUL"

Design and Control of Year 'Round Comfort Air Conditioning Systems, the series of articles by William Goodman concluded this month in Heating, Piping & Air Conditioning "is factual, clear, and very much the sort of thing that architects now busy with postwar design will find useful," the editors of the magazine Architectural Record told their readers in a review published recently.

'44 STOKER SALES UP 31 PER CENT

Factory sales of mechanical coal stokers for the year 1944 totaled 42,958 units of all sizes and types, an increase of almost 31 per cent over the year 1943, according to the Committee of Ten—Coal & Heating Industries, 307 N. Michigan Ave., Chicago 1, Ill. These figures are based on a release issued by the U. S. Bureau of the Census and on reports furnished the government by approximately 66 stoker manufacturing firms.

Class A sales—stokers having a capacity between 61 and 1200 lb per hr of coal—totaled 39,672 units in 1944 compared with 26,369 machines in 1943 and 12,054 in 1942. Sales of residential heating size stokers in 1944 and 1943 were negligible because of manufacturing restrictions imposed on the industry by WPB in the fall of 1942.

SUGGEST AIRPORT SNOW REMOVAL BY HEAT

Bulldozers, snow plows, blowers, and shovels may all be exhibits in a "Museum of Snow Removal Equipment," if snow melting lines beneath airport runways and taxiing strips materialize as quickly as some engineers think, says the A. M. Byers Co.

During December and January, many airports were closed down for days at a stretch due to heavy snows, drifts, and ice ruts. One large airport, with $100,000 invested in snow removal equipment and with help from county road crews and Army air forces personnel, had to cancel more than 300 flights over one five-day period as its runways were completely snowbound, and operated only on an emergency basis for almost a month.

Airport officials, designers, and maintenance engineers are watching the results obtained by underground snow melting lines in other industries, including truck driveways and crosswalks at industrial plants. In these installations, snow removal is approached from a new angle. Instead of moving snow after it has fallen, the underground heat lines melted the snow as it fell before it had a chance to pile up, and also evaporated the resulting water.

After observing how these lines handled a recent 13¼ in. fall of snow in Buffalo, some engineers believe that airports will require 1 in. to 1¼ in. wrought iron pipe lines spaced about 36 in. apart, and formed into grids of approximately 1000 ft circuits, laid beneath the surface of runways. Steam from the airport's boiler house could be fed into a small underground heat exchanger in each circuit for conversion into hot water to be circulated by pump. With the temperature of the runway raised to 40 or 45 deg, they say, the heaviest snowfall would melt quickly, and the cushion of warm air that would form immediately above the runway surface would rapidly absorb the water and vaporize it to the atmosphere. The result would be a clear, dry runway with little maintenance or labor expense since the system would only need to function during the few hours each winter when snow falls.

URGES MODULAR BASIS FOR POSTWAR DESIGN

Architects were urged to design postwar building projects on the modular basis, as a means of lowering the cost of construction and improving the quality of structures built after the war, in a recent statement by Tyler S. Rogers, chairman of the technical committee of the Producers' Council, 815 15th St., N.W., Washington 5, D. C., national organization of manufacturers of building materials and equipment.

"Recent adoption of new modular sizes by manufacturers of metal windows, supplementing previous agreement on sizes of brick, clay tile, and concrete blocks, and progress in that direction by manufacturers of wooden doors and windows, makes it possible to enjoy the benefits of modular planning on an important scale immediately after the war, if projects are designed accordingly," he said.

"Modular design is a plan for eliminating waste of labor and materials in construction by coordinating the dimensions of the hundreds of building products so that they will fit into the finished structure with a minimum of cutting and fitting on the job.

"In addition, modular planning reduces construction costs by saving time for architects and engineers in the designing of structures, by permitting a reduction in the number of sizes which must be produced and kept in stock by manufacturers, and by saving time and reducing the possibility of error in the actual construction."

TO PUBLISH REFRIGERATION ABSTRACTS

Announcement that J. Mack Tucker, associate professor of mechanical engineering at the University of Tennessee, has been appointed the editor of Refrigeration Abstracts, new ASRE publication, was made at the 40th annual meeting of the American Society of Refrigerating Engineers by A. B. Stickney, retiring president.

The new publication will record current refrigeration literature of engineering and scientific value. Present plans call for the coverage of foreign publications as well as those issued in English.

* * *

"The sweetness of low price is never to be overcome by the bitterness of poor service."—*A. C. Buensod, president, Buensod-Stacey, Inc., at a panel discussion on air conditioning before the New York chapter of the American Institute of Architects.*

THE EDITOR'S PAGES

PRECISION BOMBING AN AIR CONDITIONING "PRODUCT"

Revealing how the manufacturing of an instrument ball bearing was threatening to nullify our whole aircraft expansion program and jeopardize the effectiveness of our bombers, Air Technical Service Command officials at Wright Field, Dayton, Ohio, recently said that the most guarded and secret invention of this war, the Norden bombsight, was almost not produced in large enough quantities for the lack of special ball bearings on which its performance depended.

These instrument bearings required infinite attention to details every step of the way from the finished part until the bearing was finally lubricated and packaged.

Because in many cases the safe operation of the plane depended on these bearings, they had to be made as nearly perfect as man could make them. The margin of error allowed for manufacture was from 1/10,000 to 1/20,000 of an inch. They had to be dirt and dust proof, requiring special air conditioned rooms. Humidity, temperature, and air pressure had to be controlled.

WHAT TO CONSIDER ABOUT CONTROLS

In selecting the proper control equipment for a heating or air conditioning system, the following factors should be taken into consideration.

1) What is to be accomplished? Should humidities as well as temperatures be controlled or just limited at a predetermined high level in summer and a predetermined low level in winter?

2) What is the lag in the system and in the conditioned space? This is a very important point, because it is lag which causes inaccurate and undesirable results in most cases. To overcome the lags which cause overshooting and undershooting of room temperatures, the supply of heat should be continuous and at just the right temperature to exactly offset the heat loss.

3) What compromise must be made between good engineering and cost? The control system must be as simple as possible, yet it must provide good results or there is no purpose in installing the mechanical equipment.—*from a talk by John E. Haines, Minneapolis-Honeywell Regulator Co., at a panel discussion before the New York chapter of the American Institute of Architects.*

NEW ADDRESS FOR CONSULTANTS

The offices of Samuel R. Lewis, consulting engineer, and of E. P. Heckel, E. P. Heckel and Associates, were moved some weeks ago to the 21st floor of 100 W. Monroe St., Chicago. The telephone number is Andover 5270. Both Messrs. Heckel and Lewis are members of HPAC's board of consulting and contributing editors.

UNIT EQUIPMENT TO BE IMPROVED

Self-contained air conditioners will be improved greatly and extended in capacity range in the postwar period. Units will be reduced to about 50 or 60 per cent of present weight, and their physical size will be reduced. Mechanical designs will be improved to reduce maintenance to a minimum. There will be a general increase in capacity coverage from the present general maximum of 180,000 Btu to about 360,000 Btu per hr.

This class of units is principally applicable to small commercial establishments beyond the capacity of window type units. They are suitable for use with ducts. The complete package design results in low cost and permits ready removal of the unit in case of rented spaces.

In the past there has been considerable confusion caused by differences among various manufacturers in methods of testing and presenting ratings. A particularly misleading method of designating unit capacity is by use of the compressor motor horsepower because it can readily happen that one manufacturer's 2 hp unit, for example, would have the same cooling capacity as another's 3 hp unit. This situation is being rapidly corrected by the ACRMA standards and the ASRE test code, which define standards of design and establish uniform methods of testing. The air conditioning industry is becoming more stabilized, so that in the future there will not be tremendous differences between various leading manufacturers, in types and performance, as frequently occurred in the early days of air conditioning.

Self-contained air conditioning units will mainly be applied to small rented spaces and in existing buildings and homes. New, large sized buildings will incorporate air conditioning in a central system design.—*from a talk by W. S. Galazzi, York Corp., at a panel discussion before the New York chapter of the American Institute of Architects.*

CLOSING BUILDINGS TO SAVE FUEL A LOCAL DECISION

Whether use of solid fuels should be curtailed or eliminated in specific buildings and institutions in any community as a measure of conservation during the present fuel emergency in northern and midwestern states must be determined entirely by local municipal authorities, the Solid Fuels Administration for War said January 27.

Deputy Solid Fuels Administrator C. J. Potter instructed SFA field representatives, when requested, to give local officials their opinion as to the local coal supply in connection with any proposed action to conserve fuel, but emphasized that the decision and authority for closing down establishments to conserve fuel rests entirely with municipal executives.

He said that it was assumed that mayors would determine the need for and nature of any curtailment or elimination of specific uses of solid fuels only after consultation with representative persons in their own communities and after considering all pertinent factors, such as the available supply of solid fuels in the community and in the bins of consumers affected, and existing local transportation facilities.

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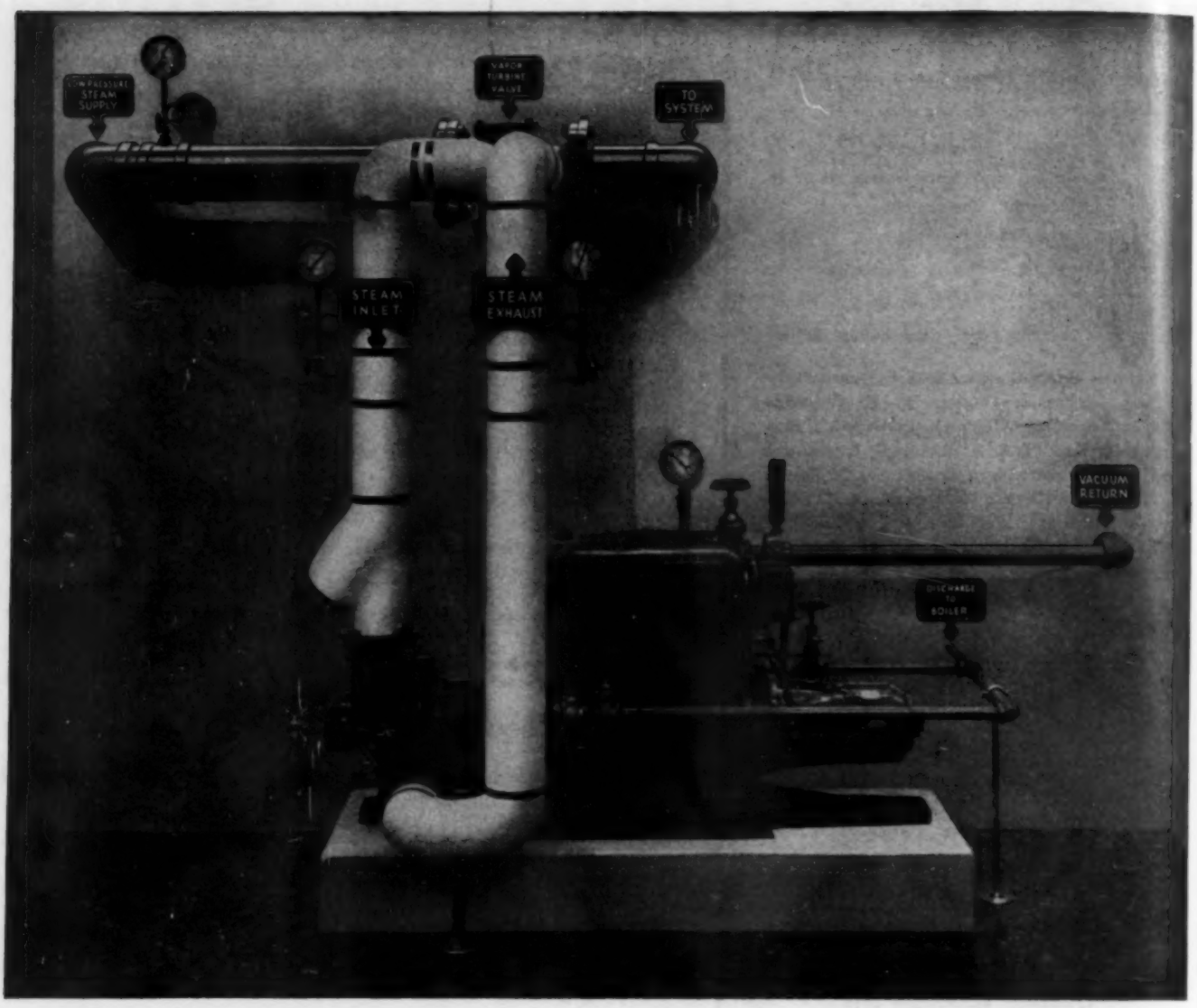
Interrupted Electric Service will not stop this NASH Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

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Background for Research . . . Mexico

By F. W. Hutchinson

BEHIND THE dry research report summarizing factual data and presenting qualified conclusions is often a warmly human background of interest not so much to engineers as engineers but to engineers as people. Mr. Hutchinson, associate professor of mechanical engineering at the University of California, writes here of Pedro and his poorly-made bricks, an example of the injustices of life; of how to recover the 20 pages of a research report blown from the balcony of the Marik hotel; of how to get your shirts back from the laundry; and of the practical grasp of combustion principles enjoyed by the assistant manager of a little restaurant around the corner from Prendes in Mexico City. The sketches are by Kay Hutchinson.

THE AIR conditioning analyst can share with Alexander Pope the poet's belief that "the proper study of mankind is man." The air conditioning engineer must use people as subjects for study and as specimens for examination. He must be aware of the fact that the refrigeration load in a theater depends in part on the degree of interest and excitement experienced by the audience; that "cold wall effect" in a heated room is more severely felt by alcoholics; that physical exertion in a hot environment may "frustrate" the heart muscle by calling upon it to make, at one time, two incompatible adjustments. When setting up heat balance equations on a human, the engineer must investigate the influence of psychological as well as physiological factors and must perform partial differentiations with respect to digestion as well as with respect to climate and weather. All of these factors serve both to complicate and to enliven the work of studying and of designing controlled atmospheric environments.

Yet research reports on air conditioning subjects are often dry summations of factual data and of qualified conclusion. To serve their purpose as records of advancement in science they probably must be so, but behind the sterile phrase and the bare equation there is often a warmly human background which defies extinction and sometimes finds a small and secretive place even in the most formal and rigorous of technical papers. To bring this small non-rational factor out in the open and to allow it the opportunity—for once—to receive some of the attention usually reserved for the facts, figures, and equations is the purpose of this article.

The general title, Background for Research, is no more than a faulty excuse for telling of some of the curious things that happen when one wanders off into out-of-the-way places. These anecdotes do not constitute a contribution to the advancement of science, but they do give a partial picture of the experiences which are left unwritten when research projects are finally reduced to print. Mexico is given first place because of the author's feeling of personal indebtedness to her generous, sincere, profoundly philosophical people. The trite old adage about memory could be rewritten to state with some accuracy the very sensible viewpoint of the Indian tribes of Mexico, "A good memory consists as much in forgetting what you don't want to do as in doing what you don't want to forget"; the much maligned philosophy of mañana may well express a viewpoint eminently more sane than that of our own sometimes ineffective devotion to speed and action. Consider, for example, the case of Pedro the woodcutter:

The Injustices of Life

Near the village of Tres Cumbres, two-thirds of the distance between Mexico City and Cuernavaca, are a number of semi-permanent habitations occupied by woodcutters. Tres Cumbres is near the crest of the western mountain range overlooking the capital (which is itself 7500 ft in elevation), hence the weather is frequently cool by day and usually cold at night. Most of the woodcutters build huts of stone and thatched brush, but one little settlement consists entirely of houses made of sun-baked adobe bricks with straw binding. Pedro lives in the least substantial looking of these huts. The walls are not well kept and the structure gives every evidence of having been put together by a man who did not regard house-building as one of the more important occupations.

What is far worse, Pedro's hut is pointed to by other residents as exemplifying the injustices of life and of fate. For anyone can see that it is not well made; that each block which went into its making did not receive the careful kneading, the rigorous compacting and compressing that is recognized everywhere as an absolute prerequisite to sound brickmaking. Pedro, being congenitally lazy—not to say slothful—did not press twice if once would do. Yet his hut alone is comfortable on the coldest nights. While others in wellbuilt huts of soundly made blocks find it difficult to keep sufficient warmth to offset the chill that comes at 8500 ft altitude, Pedro—and with only a moderate fire—is reasonably content. That this is unjust is obvious to all men. And greater still was the injustice thought to be when Pedro, alone of those in the settlement, found a ready market for such blocks as he would make for sale to an architect who came out from the city. For alone among the Indians of the Valley of Mexico, Pedro, through laziness—not to say sloth—makes blocks which

are so poorly compressed that the multitudinous pockets serve to resist heat flow and hence provide adequate insulation!

What Price a Week's Work?

The above reference to Cuernavaca brings back a clear memory of a somewhat unusual hazard faced by the manuscript of a technical paper. The writer was "officing" on a sunny balcony of the Marik hotel overlooking the tropical garden and with the snow-covered twin volcanoes Popocatepetl and Ixtaccihuatl as background. The 20 page, handwritten, rough draft of a research paper was left on a table while answering the telephone; on returning (and returning from an attempted telephone conversation in Mexico is not likely to be a rapid matter—particularly if one speaks Spanish with a California "paisano" accent) the manuscript had vanished—20 pages scattered by the wind over the roofs of assorted nearby houses. With the help of a voluntary army of small-boy chiclet sellers and shoe shiners, 17 pages of the draft were regained in an hour. Two additional pages—blurred and fuzzy—were later rescued from the hotel pool. But one page definitely could not be located. This was particularly unfortunate as the missing page was part of an appendix and contained evaluation of boundary conditions for solving an integral equation over which the writer had been puzzling for almost a week.

That evening after dinner the story of the day's misfortune was told to the itinerant peanut vendor who each night—within an hour of sunset—brings his archaic roasting drum up to the town Zocalo. "But, Senor," he said, "the missing page cannot have gone far. The city is not large. Have you searched in the fruit market?" Not having searched there, we set out at once for the fruit market—a distance of three or four blocks from the hotel. Not in the market proper, but at one side of it, a single vendor was still awaiting business. Mangoes, papaya and pineapples were arranged in orderly rows to tempt the prospective purchaser—and one page of handwritten technical manuscript was thumbtacked to one of the 4 in. x 4 in. wooden uprights which supported the roof. The manuscript page was priced at 10 centavos which, being equivalent to a few American cents, seemed not unreasonable to pay for purchase of a sheet representing a full week's work.

Returning to the hotel, we stopped by to purchase an extra bag of peanuts and to thank our friend the peanut vendor for his "inspiration" in suggesting that the afternoon's "draft" had blown the missing page into the fruit market. No one, of course, would have been so unkind as to mention that the afternoon's wind had blown from the wrong direction.

If you are interested in investigating the effect of vaso-dilation under conditions of high humidity and with intensive solar irradiation it is doubtful if a more perfect laboratory could be found than that which nature has provided on the beach at Mazatlan, Sinaloa. Situated practically on the Tropic of Cancer, Mazatlan provides warm ocean water, high humidity, intense irradiation, and a moderate dry bulb temperature. Continuing an investigation started at Ixtepec in 1942 (dealing with the length of permissible work shifts for outdoor labor by unacclimatized white laborers under tropical conditions) tests were conducted during the summer of 1944 to determine the time required for exposure of a nude subject under sedentary conditions to induce a body temperature of 101 F. The test procedure was varied as time went on to investigate the rate of work necessary to induce the 101 F in a given time and to evaluate the time corresponding to a given work rate.

Berkeley Is Very Far

Aside from the specific technical results of the tests, one factor of general interest and possibly of no little importance emerged from the experiment: Without exception, the mental state of the subject after maximum body temperature was attained was such that extreme exhilaration was experienced and ability to perform additional physical exertion was overestimated. In both of these respects the "work fever" seemed to correspond in mental effect to the condition experienced by flyers when operating at high altitude and without use of supplementary oxygen.

Unfortunately for the research, one of the subjects used in the July 1944 tests developed a fever due to factors other than climate alone and hence the work was temporarily stopped. An incident which occurred at this time points up the kind of happening which is not infrequent in Latin - American countries and is the bane of tourists and the delight of those travelers who enjoy and feel privileged to share the Latin disrespect for over-responsibility. Just before leaving the hotel the laundry came back and was found to contain three shirts which obviously belonged to some other owner. The desk clerk attempted to correct the difficulty by telephone but, finding that it would take a little time, he said he would have the shirts exchanged and would mail the right ones to California. Three months later, in late September 1944, we checked into the same hotel and were greeted in very friendly fashion by the same clerk. Even before we had time to register he brought out from under the counter a package—three neatly wrapped shirts—and with a smile and a flourish passed them over to us, saying, "Here, Senor, are the shirts. You see, two days after you went away we obtained them and we wrapped them, and addressed the package, to mail to you. But Senor, Berkeley is very far and the mail these days is not altogether dependable. So we decided to hold the package until one day—Quien sabe?—someone may stop at our hotel who also lives in Berkeley. Then we would give to him this package to deliver to you in person. Is that not well?" The obvious reply being "Si, Si, Senor—mil gracias!"

A Question of Combustion

Only an engineer can fully appreciate the magnificently formidable crepe suzettes which are available at a little restaurant around the corner from Prendes in Mexico

City. The chef does his part with exquisite skill, but when the time has come for applying a match, the liquors sizzle weakly, flash briefly, and at once go out. After the third unsuccessful attempt at lighting them, the waitress follows a routine which by now she must know well. She calls the assistant manager, who studies the situation with care, tastes the sauce, adds a small amount of liquor of anise, and unsuccessfully applies matches.

Next in the routine comes the manager, who sniffs carefully, then looks hopefully at the guest and says, "It is very good, Senor." If the guest smiles, the manager then bursts into laughter, presumably over the fact that the guest (being a good fellow) realizes, of course, that the manager's remark was intended as a show of humor. The manager then calls someone from the "to take out" counter, who shakes a liquid from a can over the crepe suzettes, which then ignite and burn merrily until the last of the cigarette lighter fluid has undergone combustion. After this the guest disposes of dessert with relish, well content in that he has experienced a gourmet's dish and an evening's entertainment all at one time; the lighter fluid has, after all, been largely consumed in the fire.

Disturbers of the Peace

Mexico City has many modern residences and large business structures for which heating and air conditioning plants have been engineered by the many skilled consultants and contractors who are residents of the country; many of these installations are outstanding examples of skillful use of materials and capable workmanship.

But not even the technical man, when traveling in Mexico, can long refrain from thinking back to the country as it must have been in pre-conquest times and of the seemingly insurmountable difficulties which were overcome by the conquerors. For those of us who take just pride in our ability to build modern naval vessels in the midwestern states and transport them —in pieces—to the coasts, it is worthy of thought to glance a second time at the mountains surrounding the Valley of Mexico and recall that Cortez had 13 warships constructed and carried—on the shoulders of men—across 30 miles of mountainous country for launching in the central lake.

And when you become involved in wartime legal technicalities, there is bitter consolation in the knowledge that the same difficulties were encountered by the military engineers who first came to Mexico from Spain; so much so, in fact, that the authorities in Mexico had lawyers barred from the country—so Prescott tells us—as "disturbers of the peace."

Or if you are worried over the fact that your child in a "progressive" grammar school is learning conchology at the expense of spelling and Korean history at the expense of arithmetic, you may find pleasure in the knowledge that the Aztecs had a committee of elders whose responsibility it was to punish faulty teaching.

Results Are What Count in Air Conditioning

RESULTS ARE of primary importance. Methods and mechanisms derive their importance largely from their effect on the economic attainment of the result. The aim of air conditioning is to produce conditions in which people can work free of the discomforts caused by temperature, humidity, excessive air motion, odor, noise, and dirt. In the well-conditioned space, the occupant should be oblivious of atmospheric conditions. It is not the purpose of air conditioning to make people "comfortably warm" or "comfortably cool." Attempts to produce a noticeable sensation result in failure.

Instrumentalities for the production of good results have been available for many years. Improvements have primarily affected cost and size. The availability of good means of air cleaning is comparatively new and the possible extension of air conditioning into the field of air sterilization is receiving accelerated attention due to its importance to the armed forces.

The technology is constantly improving but the most significant developments have been in the nature of reducing costs or actually cheapening the original installation. There have been few significant developments which affect attainable results.

Following the war, it is expected that new materials will be available for many parts of the system. The trend toward package units is bound to increase with the improvement of the units and the power of advertising.

To realize the savings in the use of package units, it is usually necessary to accept some compromise in result and these compromises vary in importance. In many cases they are justified. For large areas of reasonable permanency, the field assembled installations will, in general, remain desirable. Between the large substantial installation and the relatively small project which can be served by a completely factory assembled unit, there is a large field in which various parts of the apparatus will be grouped and shipped as one piece by the manufacturer. The dividing lines between these three types of installations will remain relatively indeterminate and will be ultimately decided by the engineering of the particular application and the sales pressure.

The importance of improvements in apparatus and devices should not be minimized, but neither should the interest in the means be permitted to obscure the result.—*From a talk by Charles S. Leopold, consulting engineer and member of HPAC's board of consulting and contributing editors, at a panel discussion before the New York chapter of the American Institute of Architects.*

SHOULD FACTORIES BE AIR CONDITIONED?

THE EDITOR—

The report from industry, Should Factories Be Air Conditioned?, by R. D. Tutt, W. E. Goohs, and F. G. Tykle of the Allison Division, General Motors Corp., published in the January issue, is very timely and brings up some points that should not be dropped without further discussion.

From a management standpoint, the completely air conditioned factory has proved its value and in postwar years the extended use of completely conditioned and artificially lighted plants is a foregone conclusion. You can no more stop the trend toward complete air conditioning now than you could stop the trend toward domestic mechanical refrigeration versus the ice man in the early 1920's.

When you ask for witnesses to testify on these subjects you should qualify your witness. In court procedure, if you produce an expert whose opinion is to be considered by the jury, you qualify him as to his previous experience and background, you qualify him as to his general familiarity with the subject he is to testify on, and you also qualify him as to his ability to express a considered opinion rather than a prejudice. Questionnaires going to the workers in industrial plants or offices will bring out increasingly the criticisms that are more interesting than the approvals, and we cannot laugh off criticisms as being prejudices.

Picking out a few of the comments printed in this report shows that there is some feeling air conditioning contributes to the common cold and sinus trouble, that there is a lack of oxygen in the air, and that there is not proper temperature control. The average man often thinks it is smart to criticize anything new or strange. He is sometimes reluctant to give approval to anything he does not understand and must, therefore, be trained in what air conditioning is and what its limitations are before he can express a considered opinion.

Everyone feels qualified to speak as an expert on heating, ventilation, and air conditioning. How many happy homes have been broken up by the endless argument between husband and wife on the subject of where and how and when to set the thermostat? People who ride trains or go to moving pictures know more about air conditioning than the engineers who design the systems they are using.

There is a basic criticism which goes through all of this work, and that is the criticism of draft, and

I would say that that is a valid criticism.

It is difficult to distribute air in order to hold temperatures without having noticeable air motion. When air motion is the right kind it is considered good ventilation; when it is the wrong kind it is considered a draft. It seems to me that the management owes it to the worker to tell him what air conditioning is, how it functions, and what its limitations are, particularly in his own plant. This can be done through the radio announcements which are common in these large plants and it can be done by printed bulletins—we have done it from time to time by placing a small printed folder in the hands of a restaurant patron—something that gives the general picture of what the worker should expect so that he will know whether he has a justifiable cause for criticism.

It is too easy for management to blame criticism on the whims of the individual instead of getting to the heart of the thing and finding that the system is not functioning as it was intended. This is particularly true in the heating season when the swing of temperatures in the supply air from warm to cold causes very bad draft effect. It is true when you get cold air falling down outside walls. Sometimes the panel cooling effect of cold walls, particularly glass block walls, is objectionable, as is the panel heating effect of walls in the summertime. Radiant effect of furnaces and ovens in the plant cannot be handled by the air conditioning system.

It is strange but true that workers who have tolerated bad draft conditions of open windows and doors will become very critical of the enclosed air conditioned space. On the other hand, there is a new criticism coming on the old plant, so that present day workers *do* object to open-door ventilation, oil vapor, excessive dust and smoke, solvent fumes, and the employer is forced to do something about it. Can you imagine an employer circulating a questionnaire as to how the worker likes the air in the foundry?

This consideration brings up one other point, which is that the owner-manager must be educated to spend enough money on the air distribution system to eliminate insofar as is possible the common complaint of draft. It is not sufficient simply to buy cooling and dehumidifying or heating and ventilating. The distribution of the air and the control from a zone standpoint is of utmost importance and costs money. From a cost standpoint it seems as though the standards of air conditioning are being raised to increase the cost, although the individual items of equipment are being reduced in cost. The ordinary owner has been slow to accept good standards of simple ventilation and heating and he is going to be equally slow to insist on good air conditioning in the windowless plant. But you cannot stop the trend any more than you can stop the trend to good lighting and good transportation.

So we have two big educational jobs to do before we have qualified witnesses. One is to educate the employee as to what air conditioning is, how it works for him, and what he can expect from it. The other is to educate the employer, the owner, to the necessity for putting in adequate equipment with good distribution and control. There is no such thing as "a little air conditioning." — LESTER T. AVERY, president, Avery Engineering Co.

CENTRAL REFRIGERATION FOR AIR CONDITIONING

THE EDITOR—

The article on page 65 (front section) of the December HPAC, entitled Central Refrigerating Plants Have Advantages for "District Air Conditioning" of Buildings, is very interesting. However, it seems to me that all of the reasons cited in favor of using cold water circulated through underground piping systems more or less overlook the basic economics of overall efficiency in engineering design.

You will recall that in the Open for Discussion columns in the January 1944 issue, I submitted some actual figures based on two large air conditioned aircraft plants, listing the auxiliary horsepower that had to be added to the prime cooling horsepower for direct expansion and for circulated chilled water as the cooling mediums. To cite those figures: the decentralized direct expansion cooling plants located at the actual points of use in each building where the end product, "cooled air," was delivered to the fan-duct systems required only 10.2 per cent additional horsepower for auxiliary equipment. The central station plant with chilled water delivered to the fan-duct system cooling coils required 45.2 per cent additional horsepower for the auxiliary equipment to accomplish the same purpose.

To me, the idea of a utility company with a water front location producing cold water or brine by large centrifugal refrigeration equipment driven by steam from a "super" boiler plant and then pumping the cold water or brine through long runs of underground street mains from which branch lines would connect it to points of use in buildings would not appear to be economically feasible.

Consider Both First and Operating Costs

The heat carrying capacity of chilled water is limited at most to a 10 to 20 deg drop through the building cooling coils. Twenty Btu per lb of water does not compare with any cooling medium in which latent heat can be utilized as well as sensible heat such as obtained with the ammonia systems serving refrigeration units in restaurants and stores in some downtown districts of large cities. Too much of our engineering seems to revolve around employing specific types of apparatus without recourse to the secondary equipment required to make the total installation for a given end product. Both first cost and operating cost are not given sufficient consideration.

Office Building System Analyzed

During the past year I have made a survey of an office building air conditioning system employing steam actuated absorption system cooling units with chilled water distribution piping. In this installation the motors driving the water circulating and cooling tower pumps totaled slightly over 100 hp for 160 tons cooling output of the absorption units. The absorption system units themselves had an end product of chilled water and better basic engineering would have been to combine the absorption units and fan served water cooling coils in adjacent locations on the building room floors with steam from the boiler plant brought to the absorption units. This would have greatly reduced the motor power required for pumping chilled water and the incidental long runs of cold water lines with costly insulation.

In the article referred to in the Open for Discussion columns in the January 1944 issue, no references were made to first cost for the two comparative aircraft plants. I have never been able to get the complete actual cost figures on the central station installation, but an overall estimate made up from such cost figures as were available indicated at least a 30 per cent higher first cost for the central station chilled water installation on a ton for ton basis. The fact that the chilled water lines served a main building which was 4000 ft long would make the total installation somewhat similar to the suggested use of chilled water served from underground mains for district air conditioning.

Now, if you consider that the 4000 ft building, thinking of it as six city blocks, has definitely acquired all of the buildings in that distance as customers, it becomes rather difficult to envisage a similar utility-served group of buildings making an economical showing with, say, not over half of the buildings on both sides of a street as customers, which would represent good utility company salesmanship. I am inclined to think that sometimes we as engineers go overboard in making a place in the sun for one type or kind of apparatus.

Another example of improper (in my opinion) basic engineering of this type which I recently checked from the possibility of adding another building to the system was a forced hot water heating system. This system had a 15 hp motor driving a hot water circulating pump serving a piping system which had two groups of overhead projection type, fan blown heaters. A simple gravity steam job would have required only a 1½ hp motor driven condensate pump as auxiliary power.

The suggested winter heating-summer cooling from the big high pressure boiler plant built around the use of large centrifugal refrigeration units reminds me somewhat of the steam heating installations installed in office buildings, hotels, and even high schools 30 to 40 years ago. These plants had high pressure boilers and employed steam engines to drive fans, pumps, and electric generators.

Load and Diversity Factors Upset Estimates

The basic idea was that you had exhaust steam as a very low cost byproduct for the building heating requirements. Around that idea plenty of auxiliary equipment was sold. Very few of these old plants are left, for the load and diversity factors upset the estimated savings in operating costs.

I have cited the above parallel cases of over-complicated engineering to prove my point, which is that air conditioning installations must always be analyzed to determine the simplest possible way of doing the job at the lowest first cost of installation. Simple installations invariably result in low operating costs. Complicated and costly plants seldom can show savings when interest and depreciation on original capital are carefully taken into consideration.—O. W. OTT, consulting engineer.

Isometrics of Advantage for Piping Drawings

By V. L. Sherman

THE WRITER has never quarreled with the use of orthographic projection in engineering drawing, but has always urged the use of perspective where it serves the purpose better. There has been a curious avoidance of real perspective in the teaching of drafting, until the wartime training programs started.

So far as engineering goes, perspective drawing is of most use when the drawing can be scaled at any point; otherwise, it is at best an unreliable picture. Perhaps the simplest approach to perspective is by means of isometric, Fig. 1, in which the foreshortening along the three axes is the same. In this figure the development of the isometric is shown by means of ordinary projection drawing. The dotted lines show the plan, front, and right side views of a 1 in. cube. Pivoting from the lower right corner of the cube, in the right side view, the cube is swung down until the upper left corner lines up with the pivotal point. By projecting the second position of the side view into the front view, the corners arrange themselves in a regular hexagon.

The circle shown dotted in the plan view now becomes an ellipse in the top face of the cube in the new front view; and since all foreshortening is the same in the three faces of the cube, each face might carry an inscribed circle of exactly the same shape. Here we must begin to be particular. If the cube is a 1 in. cube, the circle has a diameter of 1 in. And since there is no way of looking at a circle without seeing its full diameter in one direction, the long diameter of the ellipse in the isometric view must be 1 in. If it is not, the drawing cannot be scaled.

Most textbooks on drafting include isometric drawing and require that it be done instrumentally, which is rather a tough and slow job. To reduce the time, it may be taught that the longer radius arcs for the ellipse can be drawn from the centers *O*. These centers are quite accurate. But it also may be taught that by drawing the lines *OB* at 30 deg with the vertical, their intersection may be used as a center for the smaller end arc. The dotted arc, so drawn, shows how much is lopped off the long diameter by so doing. Intersecting 36 deg lines *OA* give better results.

Simplifying Isometric Drawing

But the writer is too lazy to advocate isometric drawing as instrumental drawing when better means are at hand. He is inclined to do without the "wretched rule and compass vile." He prefers a straight-edge, a good pencil, and the always necessary eraser. In Fig. 1 it will be seen that the distance between the vertical edges of the cube must be 0.7071 in., the cosine of 45 deg. Referring to Fig. 2, the distance 3.535 in. is marked off horizontally. This distance is one-half $\times$ 7.071 in. Ten units are marked off and vertical lines drawn in. Then a line is drawn across the vertical lines at 30 deg with the horizontal. At its intersections with the vertical lines, lines are drawn at 30 deg with the horizontal but with the opposite tilt. The

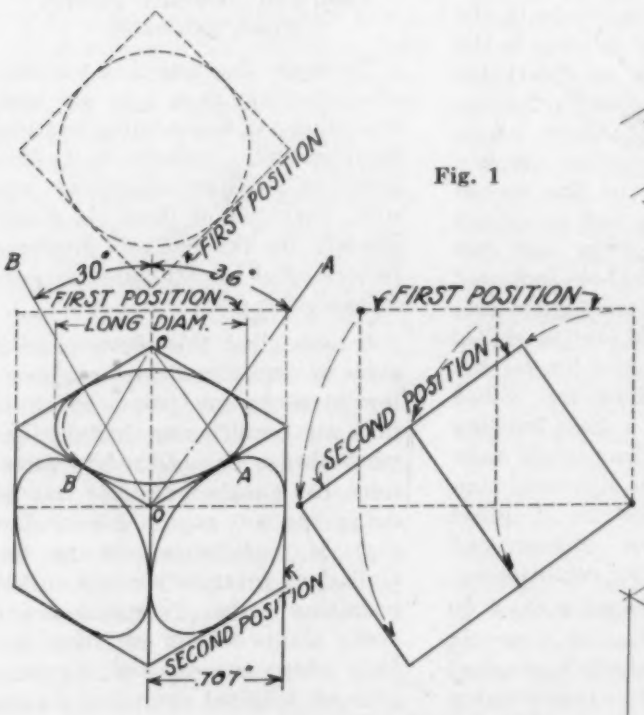


Fig. 1

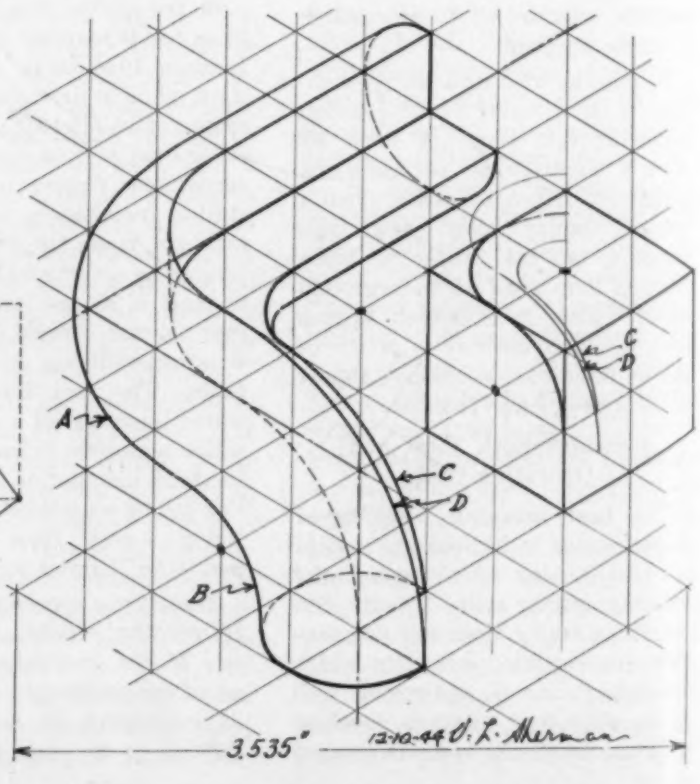
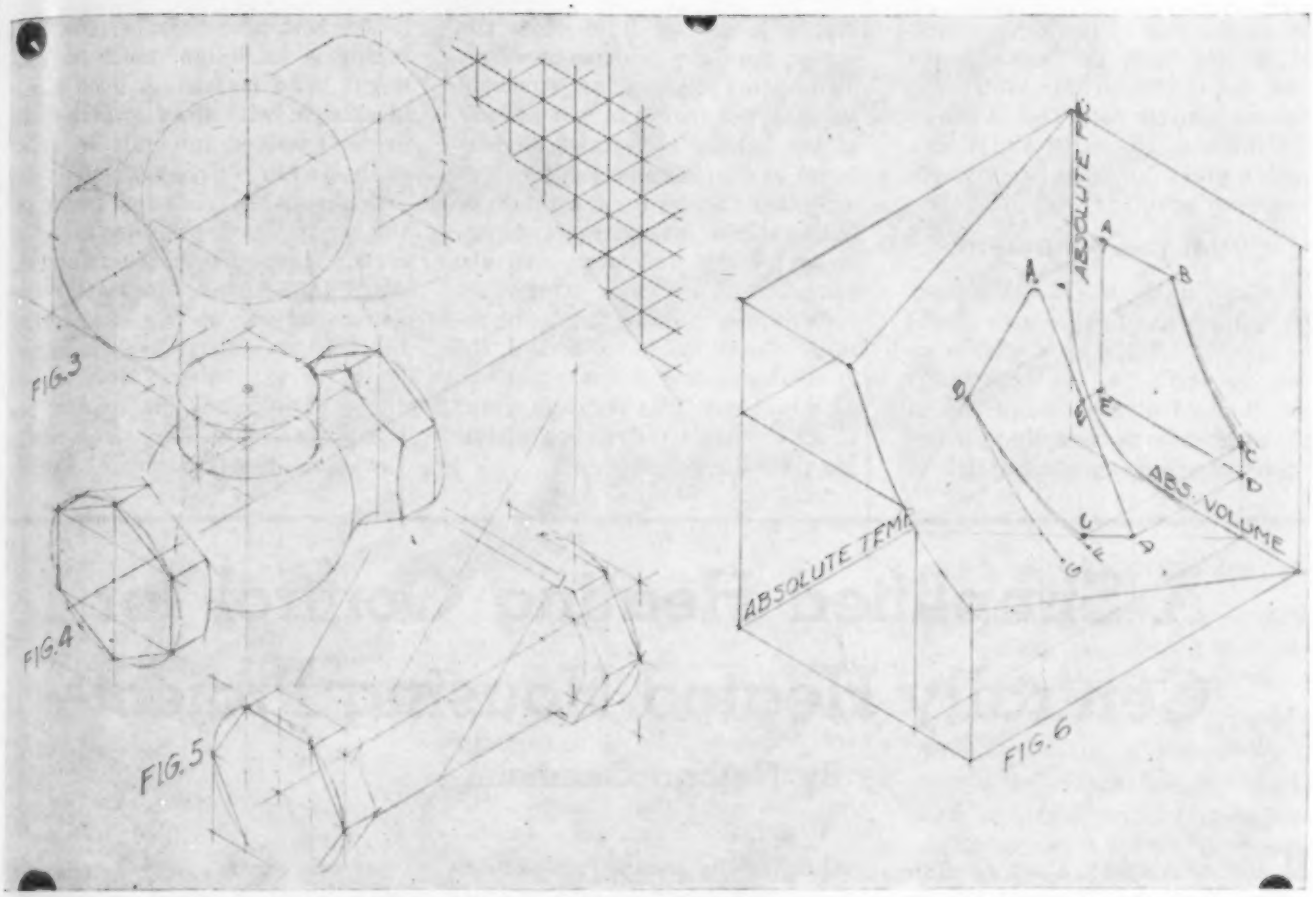


Fig. 2 (right)



resulting network gives ½ in. graduations in each of the three directions. [Before going further, it should be said that for all isometric drawings there should be a master sheet with ¼ in. layout and of good size, and that the isometric should be done on plain tracing paper over this master sheet, as indicated in Figs. 3, 4, and 5. Any scales can be applied to sketches traced over such a master sheet.]

Getting back to Fig. 2, the figure shown was used for the purpose of pointing out certain dangers in the haphazard use of isometric. One sees isometric drawings with long diameters of ellipses at odd angles with the center lines of the circles these ellipses are supposed to represent. They cannot properly be at any other than a right angle. Again, one sees piping or other constant circular sectioned pieces that seem squashed or blown at the turns. The curve marked *A* in Fig. 2 should be drawn from the same center as that from which the center line of the section is drawn. The long radius of the ellipse representing this section must be kept constant. The same goes for the curve marked *B*. But the curve marked *C*, being parallel to the curve of the center line, has the same radius. The curve *D* lies in the vertical plane of the curve of the center line. The arc is longer in radius.

There are certain objections to the use of isometric, but the advantages outnumber the faults. Using a master plate with lines carefully laid out, one can count in all directions, and with the use of a table of functions any angles can be placed. It is suggested that the beginner make use of such a master plate, sketching simple models with numerous ellipses, entirely freehand, and checking the long diameters for a while. He will find that before long his eye will tell him whether or not the ellipses are correct. Such a master sheet will prevent him from accumulating errors in measurement in the longer fabrications. He always will know how far he is from the point of departure by counting his lines and not depending on a scale.

Sketching a Valve

Figs. 3 and 4 are sketches of a valve pattern over a master sheet. The sketch is built up much as a patternmaker might build his pattern. The two ends are turned up with the globe at the midpoint of the center line. A globe or sphere can never be seen as anything but a circle. Then in Fig. 4 the ends are made hexagonal by dividing the vertical center line into four equal parts and drawing lines out to the proper points on the ellipse. For the angle valve in Fig. 5, the construction for the hexagon amounts to the same thing as before. In Fig. 5 it is seen that if

PERSPECTIVE drawing has been urged by the author for all cases where the purpose is better served by its use than it is by orthographic projection. So far as engineering goes, perspective is of most use when the drawing can be scaled at any point. Perhaps the simplest approach to perspective is by means of isometric, as shown by the sketches reproduced here. Isometric drawing is much simplified by using a master sheet (with the guide lines ruled in) underneath a plain sheet of tracing paper, as is indicated in Figs. 3, 4, and 5.

the center line of the valve seat is at 45 deg with the valve center line, the circles on this center line become entirely flat. This is one of the faults of isometric, but it isn't such a great fault and is not worth worrying about.

Further Uses for Isometric

In advocating the use of isometric, some of its further uses should be shown. With a master plate we can do easily in one view what might require three views and at the same time more easily visualize what we are doing. The sketch in Fig. 6 is too small to show the scales for the volume-pressure-temperature changes, but it should be remarked that it is just as easy to lay out an isothermal (hyperbolic) curve on isometric sheets as any other. Scales for the values of temperatures, pressures, and volumes for this indicator card are not shown, and any attempt to scale it may produce awkward results. Curve *BG* is isothermal, *BF* is adiabatic, and *BC* is expansion with heat loss. This sketch is meant to show that isometric is available for three-dimensional work.

The best use, perhaps, for isometric is in design, much as one might build models. A good sized blackboard with lines scratched at properly spaced intervals is especially useful.

A newspaper columnist friend of the writer's recently described a certain stamp in a collector's album, dated 1837. He realized after the newspaper was on the stands that his date was about five years too early for any stamp. Now he insists no one reads his column because there was nary a squawk. Let's hope this isn't true of Fig. 6.

A Simplified Heating Control for Centrally Heated Housing Project

By Nathan Cronheim

THE STANTON Road dwelling project for the National Capitol Housing Authority in the District of Columbia comprises 300 dwelling units and a community building. Most of the dwelling units will be two-story houses arranged in groups of eight, 10, or 12 to form courts while some of them will be three-story apartment buildings, containing 12 or 18 dwelling units. In order to save space, simplify the plot plan, and avoid the necessity of delivering coal and removing ashes from individual units, it was decided to heat the project from a central boiler plant.

In the system as designed (construction has not yet been started) the boiler plant will generate steam to be distributed by underground piping to 29 separate convertor rooms—one for each court, each apartment building, and the community building. At each convertor room hot water will be generated for both heating and domestic service. For heating, steam will be passed through a convertor which will supply hot water by forced circulation to the radiators of the various dwelling units through a one-pipe system. The domestic hot water will be generated and stored in a water tank and heater. The heating water temperature will be regulated by means of self-contained temperature regulator valves located in the steam supplies to the convertors, each of these valves to be operated by two bulbs—one outdoors, the other in the hot water outlet of the convertor. The domestic hot water temperatures will be regulated by self-contained valves located in the steam supplies to each tank and heater with a bulb set in the tank.

With this system, one major problem remained to be solved: How, at night or other shutdown times, can the heating be turned off without stopping the steam to the domestic hot water tanks and heaters? As the project covers a considerable area it would not be possible to have someone make the rounds of the 29 convertor rooms every morning and night, or other time, to start up or shut down the individual heating systems. An electrical or pneumatic system, controlled from the boiler plant, for a project extending over so large an area would not only be expensive but would involve the use of critical war materials. Time clocks would not answer the problem as they are too rigid in operation and do not readily allow the heating to remain on longer on Saturday and Sunday nights and very cold nights. Also, during very cold nights, it would be desirable to run the heating for a short time to prevent freezing.

The boiler plant has been designed to operate at 100 psi with a pressure drop of 20 psi to the farthest convertor room under maximum heating demand.

Pressure Controls Will Stop Heating Pumps

To solve the shutdown problem, a pressure control with switch is to be placed in the steam supply ahead of each heating water temperature regulator. The switches on the pressure controls are to be placed in the electric circuits to the circulating pumps. To shut down the heating for the dwelling units the steam pressure at the boiler room will be dropped from 100 psi to approximately 60 psi. With this drop in pressure, a corresponding drop will occur at each convertor room, causing the pressure controls to open the switches, thereby stopping the circulating pumps. The lowered steam pressure should still be sufficient to maintain the domestic hot water temperature while the heating is shut off.

To start the heating systems again the pressure at the boiler

[*Concluded on page 77*]

Design and Control of year 'round comfort Air Conditioning Systems

by William Goodman

YEAR 'ROUND CONTROL

THE FUNDAMENTAL principles that govern the design and control of year 'round air conditioning systems for comfort are organized and discussed in the series of articles of which this is the 12th and last and which have been published each month. So far, the various elements of control have been illustrated without showing a complete control system; in this section, devoted to year 'round control, a few such systems are shown and are analyzed—among them being a pre-mix type of system and an after-mix type. It is particularly emphasized throughout this series of articles that the design of the air conditioning system and the design of the control system must be carefully correlated for satisfactory results. The author is professor of mechanical engineering at the Illinois Institute of Technology, Chicago, and a practising consulting engineer. He is a member of HPAC's board of consulting and contributing editors.

So FAR in this series of articles, the various elements of control have been illustrated without showing a complete control system. The layout of a complete control system depends, of course, upon the type of air conditioning system and the results that are to be obtained. The variations in the layout of control systems are almost endless. In this section a few year 'round control systems are illustrated. They are not intended to serve as examples of what model control systems should be like, but merely to illustrate in a broad and fundamental way a few of the principles involved in a satisfactory year 'round control system. Just the main control elements will be shown; refinements can, of course, be added as needed or desired to any system.

All of the temperature control diagrams shown are, of course, purely diagrammatic. The actual connections between the various thermostats and their valves, and in the in-between instruments such as relays and cumulators, will depend, of course, upon whether electrical or pneumatic controls are used and the make of the control system. Finally, none of the commonly used safety controls have been shown as their use is well understood.

One method of control for a central system intended for year 'round comfort conditioning is illustrated in Fig. 33. Humidification is obtained by means of an air washer in which there is a dehumidifying coil for summer use. A thermostat *1* in the return air duct controls a steam valve *4* on the reheating coil. The dry bulb temperature in the conditioned space is controlled the year 'round by means of thermostat *1* and reheating coil *4*.

One Method of Control for a Central System

In winter, humidistat *2* in the return air controls steam valve *3* on the tempering coil. As the humidity in the conditioned space rises, valve *3* closes, thus lowering the wet bulb temperature of the air entering the washer. Conversely, as the relative humidity falls, modulating valve *3* opens and raises the wet bulb temperature of the air entering the washer. For this service, a nonfreeze type of coil is needed for the tempering coil or else control must be by means of face and bypass dampers instead of a steam valve.

In summer, humidistat *2* operates a modulating step controller *5*. The step controller operates the suction throttling valve *6* and the capacity control on the compressors.

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In summer it is possible that the humidistat may be satisfied and very little refrigerant may be passing through the cooling coil. However, due to a large sensible load, the dry bulb temperature may be rising in the conditioned space. For this reason a cross connection is needed between thermostat *1* and humidistat *2*. If the temperature in the conditioned space rises due to the refrigeration being shut off, the modulating steam valve on the reheater will gradually be closed. If the dry bulb temperature continues to rise after the valve is completely shut off, the thermostat *1* takes control of the step controller *5* away from the humidistat *2* and operates the refrigerating system to maintain the required dry bulb temperature. In this case the humidity in the conditioned space will drop to a point lower than the control point set on the humidistat *2*. This, however, is not objectionable during the summer in a comfort installation.

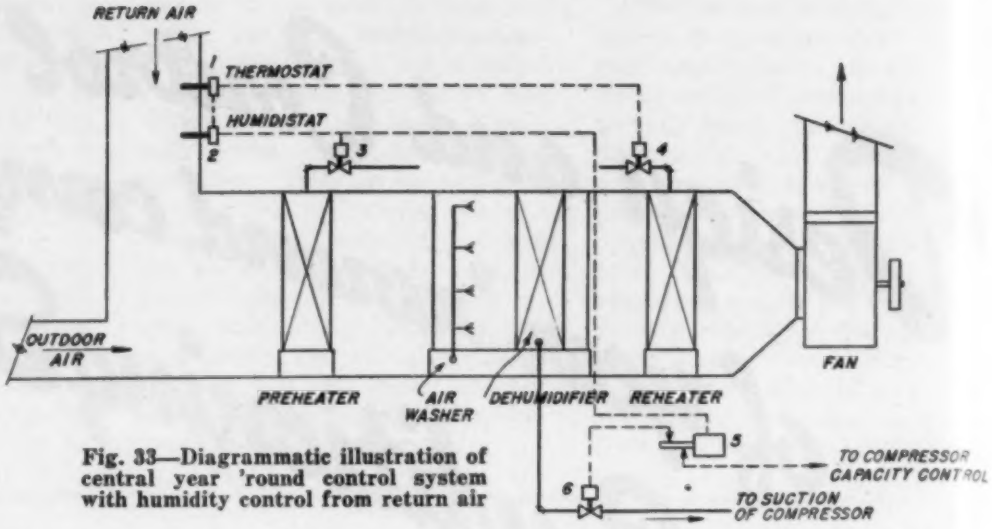

Fig. 33—Diagrammatic illustration of central year 'round control system with humidity control from return air

Instead of using a direct expansion coil for dehumidification, it is possible to use chilled water in the dehumidifying coil. In this case the control would be exactly the same. The humidistat *2* would operate the step controller which in turn, by operating the compressor and back pressure valve *6*, would raise or lower the temperature of the refrigerant inside the water cooler coil [as shown in Fig. 22 on page 626 of the November issue of HPAC] in accordance with the dehumidification requirements of the conditioned space.

In the system illustrated in Fig. 33, reheating could be accomplished by means of a condensing coil instead of a steam reheating coil. In this event the dry bulb thermostat *1* would control the face and bypass dampers around the reheating condenser coil, as illustrated in Fig. 21 on page 626 of the November issue.

Zoned Primary Air System of Pre-Mix Type

A zoned primary air system of the pre-mix type is illustrated in Fig. 34. The primary air is cooled by direct expansion coils whereas the secondary air is cooled by chilled circulating water. This arrangement is satisfactory inasmuch as the primary air must be cooled to a much lower temperature than the secondary air. A separate secondary coil is provided for each zone. Individual throttling valves *7* to *12*, inclusive, are installed on each secondary coil to regulate the flow of water. Each of these throttling valves is to be controlled by means of a separate dry bulb thermostat located in the individual zones.

During the summer, the temperature of the chilled water supplied to the secondary coil is controlled by thermostat *13* in the water line leaving the water cooler. If desired, the temperature of the chilled water can be reset by outdoor thermostat *14*. As the outdoor temperature rises, the temperature of the chilled water will be raised. Ther-

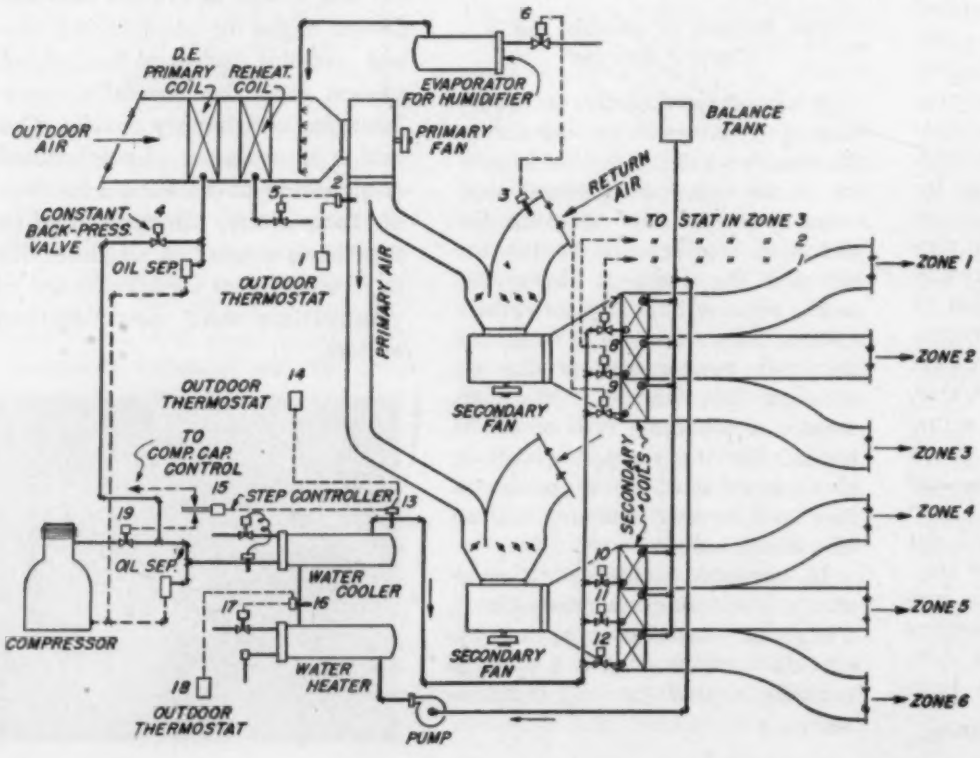

Fig. 34—Diagrammatic illustration of one type of zoned primary air system of pre-mix type for year 'round air conditioning

mostat *13* regulates the position of the step controller *15*, which controls the throttling valve *19* in the suction line between the water cooler and the compressor. Additional contacts on the step controller *15* also control whatever capacity controls are provided for the reciprocating compressors. In this manner, thermostat *13* not only controls the temperature of the chilled water supplied to the secondary coils so that there will be little possibility of moisture condensing on the secondary coils, but also provides economy in the operation of the compressors. Nevertheless, drain pans should be provided under all secondary coils because condensation cannot be avoided under all conditions. This is particularly true if the outdoor thermostat *14* is omitted.

No control is provided in Fig. 34 for the dew point of the primary air supply. If a primary coil of sufficient size is installed to avoid frosting when the outdoor temperature is low, the primary air can always be cooled to a low enough dew point temperature. The dew point temperature of the primary air leaving the coil will vary with the temperature of the evaporating refrigerant. The temperature of the evaporating refrigerant is in turn controlled by thermostat *13* in the chilled water leaving the water cooler. As the outdoor temperature drops, thermostat *14* lowers the temperature setting of thermostat *13*. Consequently, thermostat *13* acting on step controller *15* and suction throttling valve *19* lowers the temperature of the evaporating refrigerant as the outdoor temperature drops. In this manner the dew point temperature of the primary air leaving the cooling coil is also lowered.

A back pressure valve *4* can be installed in the suction line from the direct expansion primary coil in order to make sure that the minimum pressure in the direct expansion coil under light load will be high enough to prevent frosting. For all higher evaporating temperatures, the back pressure valve will be inoperative and wide open.

In examining the control system of Fig. 34 it may appear at first glance that with a very light load on the water cooler, thermostat *13* acting through the capacity control might cut out so much compressor capacity that there might not be sufficient left to carry the load on the primary coil. This cannot occur because if the primary load is too great for the compressor, the back pressure on the compressor will rise. In this case the back pressure inside the water cooler will also rise and consequently the water temperature will tend to increase. As a result, thermostat *13* will act on the step controller to open valve *19* wide and then to bring on sufficient compressor capacity for both the primary cooling load and the water cooling load.

Operation During Intermediate Seasons

During the intermediate season —say when the outdoor temperature is roughly between 50 and 65 —thermostat *13* maintains the temperature of the chilled water at a constant point. However, outdoor thermostat *1* readjusts thermostat *2* which, in turn, controls the admission of steam to the reheating coil. In this manner the temperature of the primary air is changed in accordance with the outside air, as illustrated in Fig. 16. In intermediate weather either heating or cooling can be provided for all zones and any different zones can be heated and cooled at the same time, as previously discussed in connection with Fig. 16 on page 457 of the August HPAC.

After the outdoor temperature drops below 50 F, outdoor thermostat *1* resets thermostat *2* so that the outdoor air is always reheated to about 50 F by means of steam supplied to the reheating coil. At the same time, thermostat *16* in the path of the water leaving the water heater controls the admission of steam to the heater through valve *17*. An outdoor thermostat *18* resets thermostat *16* so that the temperature of the water is changed in accordance with the outdoor temperature. The lower the outdoor temperature, the higher the temperature of the water circulated through the secondary coils. Thermostats *13* and *16* must be interconnected, of course, so that when the heater is on, the water chiller and refrigerating plant cannot be operated, and vice versa.

During the winter, humidity control is by means of humidistat *3* in the return air from one group of zones. Humidistat *3* controls a modulating valve *6* which, in turn, regulates the supply of steam to the water evaporator for the humidifier. The vapor from the humidifier is supplied to the primary air through a perforated pipe. As has been stated previously in these articles, primary air systems are suitable only for buildings in which the character of the load throughout the various zones is approximately the same. Also, as has previously been stated, comparatively wide variations in humidity will not affect the comfort of the occupants of the building. Consequently a humidistat installed in the return air from one group of zones will provide sufficient regulation for the humidity throughout the building. The only purpose of the humidity control is to prevent over-humidifying of the building in winter. In this connection, in some installations it might be desirable to install an outdoor thermostat to readjust the setting of the humidistat *3*. As the outdoor temperature drops, the relative humidity would be lowered to prevent condensation and frost on windows.

Primary Air System of the After-Mix Type

In Fig. 35 a primary air system of the after-mix type is shown—a single secondary fan supplies air through a secondary air duct to a number of different zones. A primary air fan and separate primary air duct also supply air to the various zones. At every air outlet a connection from both the secondary and primary air ducts is made.

Even though two ducts are required for the system illustrated in Fig. 35, it should not be confused with the double duct system. In a double duct system each duct must be capable of carrying practically the full volume of air, as at different times all of the air may be delivered through one or the other of the two ducts. On the other hand, in the system shown in Fig. 35, the primary air duct is very small compared to the secondary air duct; it is roughly about 20 per cent of the area of the secondary air duct. Furthermore, the quantity of air supplied through the primary air duct is constant at all times. The secondary duct is

of such an area as to carry only about 80 per cent of the total air supplied.

Temperature control in each zone can be by means of a volume damper located only in the secondary air ducts. Each volume damper is operated by separate damper motors *3* and *4* controlled by individual dry bulb thermostats *5* and *6* located either in each zone or in the return air from each zone. The supply of primary air is constant at all times so that the temperature control does not in any way interfere with either ventilation or dehumidification in the zone. With a volume control system it is, of course, necessary that air outlets in the zones be of such a type that the distribution of the air in the room will not be affected by the decrease in volume supplied through the secondary air duct.

A static regulator *14* is needed on the secondary air fan so that the pressure maintained in the secondary air duct will be constant regardless of the position of the volume dampers in the various zones. In Fig. 35, direct expansion coils are used for both the primary and secondary coils. In this case somewhat better operating economy can be obtained if separate compressors are used as shown for the primary and secondary air coils. The refrigerant supplied to the primary air coil should be at a much lower temperature than the refrigerant supplied to the secondary coil. If only one compressor were used for the entire load, the operating cost would be increased because it would be necessary to carry the entire load at the low evaporating temperature required for the primary air coil. Inasmuch as a good per cent of the load is on the secondary coil, the operating cost of the entire system would be penalized merely in order to carry a low enough temperature for the primary air load.

No control for the dew point of the primary air supply is shown in Fig. 35. As the outdoor temperature drops, the load on the coil will fall and the temperature of the evaporating refrigerant inside the coil will also fall. In this manner, as the outdoor temperature drops, the dew point temperature of the primary air supply will also be lowered. The back pressure valve is used only as a limiting device to prevent frosting under light load conditions. At all other times, the back pressure valve will be wide open.

The temperature of the secondary air supply is controlled by thermostat *8* adjusting throttling valve *10* in the suction line to the secondary compressor. Thermostat *8* should be reset by means of an outdoor thermostat *9* so that as the outdoor temperature rises, the temperature of the secondary air supply to the various zones will also be increased. In this manner, some limitation of zone temperatures will be obtained while at the same time the temperature of the evaporating refrigerant inside the secondary cooling coil will be maintained at a high enough point to minimize the possibility of condensation of moisture from the air.

During the intermediate season, when the outdoor temperature is between 50 and 65 F, the temperature of the primary air is controlled by thermostat *1*, which controls throttling valve *2* to regulate the supply of steam to the reheating coil in the primary air stream. Outdoor thermostat *16* resets thermostat *1* in such a manner that the temperature of the primary air is raised as the outdoor temperature falls as discussed previously and as illustrated in Fig. 16 on page 457 of the August HPAC.

During the heating season, after the outdoor temperature falls below 50 F, thermostat *1* maintains the temperature of the primary air at about 50 F. At the same time the secondary air is heated under control of thermostat *13*. This thermostat acting on steam valve *12* admits steam to the heating coil in the return air to the secondary fan. Thermostat *13* should be reset by an outdoor thermostat *11* in accordance with the outdoor temperature so that as the outdoor temperature falls, the temperature of the air supply can be raised. During mild heating weather the secondary air would be supplied at relatively low temperature, which would help to minimize overheating and also keep the volume dampers fairly wide open at all times. A connection (not shown) would, of course, be needed between thermostats *8* and *13* so that steam could not be supplied when the compressor was running, or vice versa.

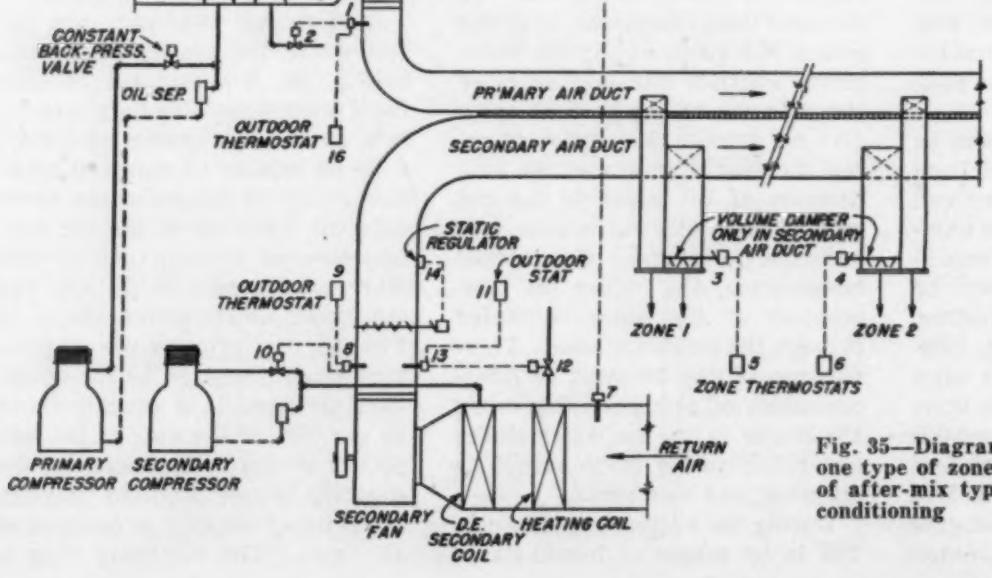

Fig. 35—Diagrammatic illustration of one type of zoned primary air system of after-mix type for year 'round air conditioning

During the winter, humidity could be controlled by means of humidistat *7* in the return air to the secondary fan. Humidistat *7* acts on steam throttling valve *15* on the evaporator for the humidification. The vapor from the evaporator is added to the primary air through a perforated pipe, as shown.

Should Outdoor Thermostats Be Used for Resetting in Summer?

For the control systems shown in Figs. 34 and 35, the temperature of the secondary air supplied to the zones is increased during the summer as the outdoor temperature rises. In this manner the lowest temperature that can be maintained in the zones is limited. This is desirable, of course, not only because it makes for better operating economy, but also because it prevents too marked a contrast between the indoor and outdoor temperatures. However, increasing the lowest temperature that can be carried in the zones with increasing outdoor temperatures may also make for complaints in those buildings in which the occupants are in the conditioned atmosphere for several hours continuously. Under these conditions there is some tendency for occupants to demand lower indoor temperatures than in occupancies such as theaters or restaurants where people are in the conditioned atmosphere for only a short time. Consequently, in such buildings it may be necessary for the building operator to lower the settings of the thermostats controlling the temperature of the air supplied to the zones or the temperature of the circulating water supplied to the secondary coils. In this case, the outdoor thermostats for resetting these temperatures become almost useless.

It is, therefore, wise to consider for each building project whether or not outdoor thermostats should be used for resetting the summer thermostats controlling either the temperature of the secondary air or the temperature of the water to the secondary coils. In winter, of course, outdoor thermostats for regulating either the temperature of the water to the secondary coils or the temperature of the secondary air are desirable under all conditions and greatly improve the performance of the heating system.

* * * *

There are many ramifications to the subject of designing year 'round air conditioning systems and their associated control systems. No attempt has been made in this series of articles to cover every possible case. An effort has been made only to illustrate the defects in some common types of systems and controls, to illustrate enough systems to give the reader an idea of the requirements of a satisfactorily operating system, and to emphasize the necessity for carefully correlating the design of the control system and the air conditioning system. The two must be considered as an integral unit if satisfactory results are to be obtained.

SIMPLIFIED HEATING CONTROL —

[*Concluded from page* 72]

plant will be raised to 100 psi. With this rise, the corresponding rises in pressure at the convertor rooms will cause the switches to close and the circulating pumps to resume operation.

As the boiler plant will be adjacent to the community building, the convertors for the community building will be located in the boiler room. Here the pressure control with switch will be omitted and in its place will be a hand operated switch so that the community building can be heated independently of the dwelling units. It is believed these controls will give complete flexibility for easily starting or stopping, at any time, the heating in the dwellings and community building. When the circulating pumps are not running the water temperatures in the heating convertors will remain at temperatures slightly above those called for by the outdoor bulbs of the temperature regulators. This will give a small reservoir of heat to help when starting up the heating.

The pressure controls with switches specified have a range of 0 to 150 psi, to close the circuit on a pressure rise and open on a minimum pressure fall of 6 psi. These switches, with their wide range, will give flexibility of adjustment. They will probably be set to open the circuits at 64 psi and close the circuits at 70 psi.

Variation of This Type of Control

During a discussion of the above solution with Dean John A. Goff of the Towne Scientific School of the University of Pennsylvania, he suggested a variation of this control that may be applicable to some remote control installations. Dean Goff's variation would use a pressure control with switch that would operate only on drops in pressure or on rises in pressure. For example, if the switch is closed, the switch opens on a drop in pressure and remains open when the pressure is raised. Then the next time the pressure is dropped the switch will close. This switching arrangement could be used where it is necessary to maintain a high pressure at all times except for those momentary drops in pressure for reversing the switch or switches.

Other types of heating temperature regulators could be used with these pressure controls with switches but each should be carefully studied to assure satisfactory operation.

This article has been written before the construction of the work and the testing of its operation in the hope it may be of assistance in the design of other work to be constructed in the near future.

George Howe and Louis I. Kahn are the architects for this project; John Irvine & Associates are the site, boiler plant and electrical engineers; and the author is the mechanical and structural engineer.

* * *

● *Moving to avert a critical shortage of industrial fuel oil on the East Coast, the Petroleum Administration for War called upon* 87 *large scale consumers to use standby facilities that already have substitute fuel on hand, it was announced January* 30.

The 87 *consumers were requested to begin using their coal burning standby facilities because a survey conducted by PAW showed that all of these consumers had as much as* 30 *days' supply of coal stocked for such emergency use.*

SAM LEWIS' PAGE

What Goes Out Must Come In

IT IS interesting to continue arguments. For example, some time ago I wrote a piece about the necessity of "putting in" if you expect to "take out." Of course, I could have attempted a sermon on the subject, since all of us who have white hair have learned that the way to receive happiness and pleasure is to *give* happiness and pleasure, but I stuck to engineering aspects—such as the following.

I was called on recently to test and to certify to a very large air exhaust system in an educational building. I was told that my business was to measure the exhaust; that I should not concern myself with the supply; that leakage would provide enough air to replace that to be removed. Under protest, therefore, the exhaust volume was measured, without operating the unit ventilating machines that someone else furnished. Sure enough, the exhaust system was proved woefully deficient and it became necessary to place the supply system in operation. Now I am saying, gently, "I told you so."

In 1926 I designed the mechanical equipment for a skyscraping, cooperatively owned, apartment building. We provided definite and adequate air inlets and ducts to give air supply to the boilers for combustion purposes, and we arranged separate inlets and ducts for each room that enclosed the rubbish and garbage incinerators, as well as adequate air intakes to the two service stairwells so that some air could reach the kitchens to supply the kitchen exhaust fans. This was an early attempt to provide intelligently for the 20,000 cfm of air required for combustion and scavenging in such a multifamily structure 21 stories high.

The scheme is reported to have worked out well for several years, but now I am called back to diagnose complaints and prescribe remedies. Someone thought that it was an extravagance to provide outside air intakes and burn fuel for warming air that was, anyway, wasted up the chimneys and blown out through the exhaust fans. So they shut off the air heaters. Then the entering cool air chilled the janitor as he fired the incinerators and rested in the boiler room watching the stokers, so they sealed up all the intake ducts.

The suction of all the exhaust fans plus that of the chimneys, plus the chimney-like reactions of any tall building that does not have each story isolated by doors, causes such deficiency in atmospheric pressure at the first story that only a woman of Amazon strength can force open an outside door, and the wind "pipes and whistles" in its attempt to enter. The kitchen odors are well advertised and even the fireplaces try to regurgitate.

This, therefore, is a reiteration of my homily, that you cannot reap without sowing. We are now replacing the controlled air supply for this building. Intelligence in construction of such buildings suggests, however, that each successive story should be isolated from the others by tight doors, such as one sees in most modern tall office buildings.

IN THIS regular feature—a page more or less in length—informal comment on heating, piping, and air conditioning problems and their solutions is given—at the request of the editors—by Samuel R. Lewis, consulting engineer, and a member of HPAC's board of consulting and contributing editors. This month, he stresses the point that if air is to be exhausted from a building it is essential to provide for air to be supplied, and cites as an example some difficulties along these lines encountered in the case of a 21 story building.

DESIGN NEW BUILDINGS FOR AIR CONDITIONING

THE EDITOR—

Concerning the report, Should Factories Be Air Conditioned?, in the January HPAC, I believe that the authors could have fortified their point by mentioning the fact that under good air conditions, the drafts and inequality of temperatures within the same room can be eliminated, and therefore the type of exposure which is so frequently the cause of the common cold has been ruled out.

Also, another point is that under air conditioning it is possible to have more soundproofing, and that the extraneous noises so common to plants and city offices constitute one of the greatest sources of nervous fatigue.

A Timely Paper

I believe that this is a timely paper because of the demand for new buildings after the war and it will be very important to design them for air conditioning and include the necessary ducts within the permanent construction. The saving on heating and upkeep would practically take care of the cost of comfort cooling. It would be well to emphasize the fact that control of humidity is of greater importance than the actual cooling.
—ALBERT G. YOUNG, M.D.

Operation

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Maintenance

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Repair

•

Alteration

•

Extension

Night Air Cooling Solves a Wax Paper Storage Problem

By Bernard G. Silberstein

THE SPECIALTY Paper Co., Dayton, Ohio, has been manufacturing waxed paper for many years and has constantly been confronted with spoilage problems during summer months. The loss due to this type of damage ran into many thousands of dollars and had been the subject of considerable research. A careful checking of the whole process from the time fabrication was completed until the waxed paper rolls were delivered to the most distant customers showed that a very small percentage of rolls were damaged by the heat in transit after leaving the warehouse and the problem then narrowed down to methods of keeping the rolls cool enough in the storage rooms to keep the sheets from sticking to each other.

The warehouse consists of two rooms, end to end, each room 180 ft long and the two rooms in the shape of a wedge with an extreme width of 80 ft at one end of one room narrowing down to 60 ft at the extreme end of the other room. The average ceiling height is 28 ft, which gives the two rooms a total of 705,600 cu ft. So far as the physical characteristics of the rooms are concerned, there is a 4 in. concrete floor on the ground, the walls are 8 in. brick, and the roof is 2 in. wood with tar and gravel.

The first thought was to cool the entire space by refrigeration and figures were obtained along that line. The tonnage required would obviously be quite large and the cost was estimated at about $60,000, with a high operating cost in addition. It seemed that the problem could be solved in a much less expensive way by using the principle of "night cooling." The waxed paper is stacked in such a way that there is ample space for the air to pass between the rolls and consequently it was a question of using past experience to determine the number of air changes and the location of the equipment.

The skylights running the length of both rooms provide an ideal location for the ventilating fans, and, of course, the scheme requires the introduction of cool night air at the floor level and exhaust at the roof. Because of the height of the ceiling, it didn't matter whether the air was introduced more from one side or the other, but fortunately the warehouse has a large

SPOILAGE OF rolls of wax paper in the summer months was traced to high temperatures in the warehouse where the paper was stored before shipment. It was felt that the problem could be solved by employing the "night cooling" principle, bringing in air during the night at the floor level and exhausting it at the roof. Based on past experience, it was decided that an air change every four minutes would do the job, and the calculated capacity was divided up among 10 fans. The fans are under time clock control and run from 2:30 a.m. to 5 a.m. The author, who engineered the job, is with the Ilg Electric Ventilating Co.

number of doors on both sides of the building for this purpose. Inlet louvers at the floor level were considered instead of relying on the doors, but inasmuch as a night watchman is always on duty, the louvers have not been installed.

In deciding upon the number of fans to install, an air change about once every four minutes was assumed (based on past experience), and by deducting the estimated volume of the material being stored, the total air to be handled by the fans was figured as 150,000 cfm. This was divided up among ten fans, spacing them equally along the skylight.

Fans Under Clock Control

Rather than to rely on the watchman to turn the fans on and off, electric time clocks were installed to control them. The chief engineer first tried a running period from 9 p.m. to 6 a.m. The results for a two week test period with extreme daytime temperatures averaging 96 deg and midnight temperatures averaging 70 deg were completely satisfactory, so the next move was to see if a shorter running period would accomplish the desired objective. For a considerable length of time, with equally high daytime temperatures and similar night temperatures, the system has run only from 2:30 a.m. to 5 a.m. and then the warehouse has been carefully closed up to retain the cool air until the next running period the following morning. Apparently this length of night cooling in the severest heat is sufficient to cool not only the waxed paper but the inside of the entire warehouse. It is not believed, however, that as satisfactory results would have been obtained if the floor were wood on concrete, in which event a longer running period would probably be required.

Ten fans were installed to give a four minute air change

Uncle Sam Asks You to Avoid Overheating— Save Coal, Oil, Gas!

NELSON HEADS FAN GROUP

At the twenty-eighth annual meeting of the National Association of Fan Manufacturers held last month, the following officers were elected for the ensuing year: R. H. Nelson, president; C. T. Morse, vice-president; and L. O. Monroe, secretary-treasurer.

Mr. Nelson is president of the Herman Nelson Corp., and Mr. Morse is president of the American Blower Corp. Headquarters of the NAFM are at 5-208 General Motors Bldg., Detroit 2, Mich.

KOHLBRY PRESIDENT OF IUHA

At the nineteenth annual meeting of the Industrial Unit Heater Association last month, F. P. Kohlbry was elected president; N. Downey was elected vice-president; and L. O. Monroe, secretary-treasurer. Mr. Kohlbry is president of the Airtherm Mfg. Co., and Mr. Downey is manager of the unit heater division of the Trane Co.

Maurice Failer operating overhead valve from portable safety platform. Being mounted on casters, the platform is always available and can be easily moved

A new suspended type platform at the Boulevard heating plant makes it easier for Joe Cameron and John Bezyak to replace diaphragms in reducing valves

Taifick Essa applying a special nonslip preparation to water for mopping the showers and locker room. The department recognizes the hazards of slippery floors

Jimmy Quinn using a face guard to inspect a blazing fire through an observation door. This guard protects the eyes, face, and the hand from excess glare and heat

SAFETY in Heating and Piping Work

EMPLOYEES of The Detroit Edison Co.'s central heating department are always anxious and ready to improve their job methods and techniques. As a result of this cooperative spirit, accidents have been kept at a minimum, and a good safety record has been established at each of the heating department's four plants. The importance of working safely is continuously stressed.

Meetings are held each month at the plants where the men are given an opportunity to offer suggestions for safer equipment and practices.

The safety program in the electric, steam, gas, and water divisions of the company is conducted under the supervision of Safety Engineer Robert P. Douglas, and his assistant, Clancy L. Nanry. In the central heating department the safety program is under the direct supervision of Rudolph G. Felger, assistant engineer of central heating.

The top of the coal bunker doorway has been raised. Domenick Coccia now has no fear of bumping his head

Ed Streten uses new full-view goggles over his glasses for added protection while air blowing a coal tripper

Jack Knaus had a tough time (left) getting in and out of boiler mud drums. This hazard was recognized and corrected by introducing the platform mounted on the ladder shown in the picture at the right

WARTIME FUEL EFFICIENCY

How to Estimate Stack Loss

By R. K. Deutsch and Kalman Steiner

IN THE review of combustion elements on pages 31-33 of the January HPAC, it was stated that for rapid estimation of stack losses, charts are available showing heat loss for varying percentages of carbon dioxide in the flue gases at various flue gas temperatures. Reproduced here for the first time are two new charts which may be used for finding the stack loss for a given CO_2 percentage and stack temperature for any solid or liquid fuel, and for some gaseous fuels.

The first chart plots excess air percentage as a function of CO_2 in the stack gas and a ratio $[1 + (3H/C)]$ of the amounts of combustible hydrogen and carbon in the fuel.[1] For convenience, the line showing "Composition Ratio of Fuels" on the chart is marked for certain representative fuels. It should be borne in mind, however, that the particular anthracite represented on the chart may not have the same composition as the anthracite actually being used, so for the most accurate work, the analysis of the specific fuel being burned should be used.

To use the excess air chart, Fig. 1, locate either the fuel being used or the composition ratio of the fuel on the right-hand scale, and the per cent CO_2 in the stack gases on the left-hand scale. Connect these points with a straight-edge to find the per cent excess air at the intersection of the straight-edge with the middle scale.

The second chart, Fig. 2, plots the loss due to heating the excess air as a function of the per cent excess air (as found from Fig. 1), the stack temperature, and a "Fuel Heat Ratio."[2] The fuel heat ratio $\{[(C/12) + (H/4)]/(\text{Net Btu per Lb})\}$ is a ratio of the relative amounts of carbon and hydrogen in the fuel to the heat content of the fuel. For convenience, certain representative fuels have been entered on the fuel heat ratio line of Fig. 2 as in Fig. 1; these may be used as such, or the precise value for the fuel being burned may be calculated.

To use this chart, connect the fuel heat ratio line—the left-hand scale—with the stack temperature line and mark the intersection with the reference line. Then connect the marked point on the reference line with the per cent excess air being used. Where this last line crosses the per cent stack heat loss line, read the per cent of heat lost due to excess air.

Analyzing Flue Gases

Most engineers are familiar with methods for the determination of carbon dioxide in flue gas, but the art of detecting and evaluating the percentage of carbon monoxide is not so well developed or in such widespread use. In fact, the determination of carbon monoxide presents definite technical problems. A very good summary of the subject will be found in Bureau of Mines Technical Paper 582, obtainable from the Government Printing Office in Washington, D. C., for 10c; the title is Methods for Detection and Determination of Carbon Monoxide.

Many portable commercial sets used by combustion men for analyzing flue gases are equipped with absorption bulbs as follows: caustic potash solution for CO_2, pyrogallic acid solution for oxygen, and cuprous chloride in ammoniacal solution. There are two serious objections to the latter two solutions. Pyrogallic acid absorbs oxygen rapidly from the atmosphere, and so should be prepared fresh just before use, and ammoniacal cuprous chloride releases fumes of ammonia, so that even though the solution absorbs the gas CO, it

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[1] The equation on which Fig. 1 is based is

$$(1 + \%\ \text{excess air}) = \frac{21}{\%CO_2\left(1 + \frac{3H}{C}\right)}$$

which is derived from stoichiometric considerations, and neglects the effect of CO. The CO effect may be included by using $(CO_2 + \frac{1}{2}CO)$ instead of CO_2.

[2] The equation on which Fig. 2 is based is

$$\text{Per cent heat loss} = \left[\frac{\frac{C}{12} + \frac{H}{4}}{\text{Btu/lb}}\right] \times [T_s - T_r] \times \text{per cent excess air} \times 114.5$$

where T_s = stack temperature, T_r = room temperature (50 F), C = per cent combustible carbon in fuel, H = per cent combustible hydrogen in fuel, and Btu/lb is the heat content of the fuel. This equation neglects the effect of CO in the flue gases. The per cent loss due to unburned CO may be calculated from

$$\frac{9600}{\text{Btu of fuel}} \times \text{per cent carbon in fuel} \times \frac{CO}{CO + CO_2}.$$

THE MOST widely used index of the efficiency of combustion of a fuel is the carbon dioxide content of the flue gases. As the percentage approaches 21 (the theoretical value for pure carbon), the more nearly perfect is the combustion process. The actual value of the theoretically perfect carbon dioxide percentage obtainable with any particular fuel depends upon the fuel's composition. The new charts presented here may be used for finding the stack loss for a given CO_2 percentage and stack temperature for any solid or liquid fuel, and for some gaseous fuels . . . Mr. Deutsch, a chemical engineer, is technical products manager with the Shell Oil Co., Inc., and Mr. Steiner, a member of HPAC's board of consulting and contributing editors, is consulting engineer for the C. Hoffberger Co.

may add the gas NH_3 to the sample, and so give entirely erroneous readings. It is recommended that cuprous chloride be used in acid solution instead, and that after the gas sample is passed through that solution, it be repassed through the caustic solution to absorb any acid fumes that might have been added to the sample in the cuprous chloride solution. Then the reading will be fairly accurate. It is also important that the cuprous chloride be freshly prepared just before use, for it also absorbs oxygen rapidly.

NOTE—The selected fuels indicated on these charts are representative only. Actual values for certain bituminous coals, for example, will vary from 112 to 122 for the composition ratio and from 0.000542 to 0.000585 for the fuel heat ratio. As in all previous stack loss charts, the hydrogen loss due to non-condensation of water vapor in the stack gases is not included. As this loss is a constant for any one fuel, it may be disregarded for most practical purposes.

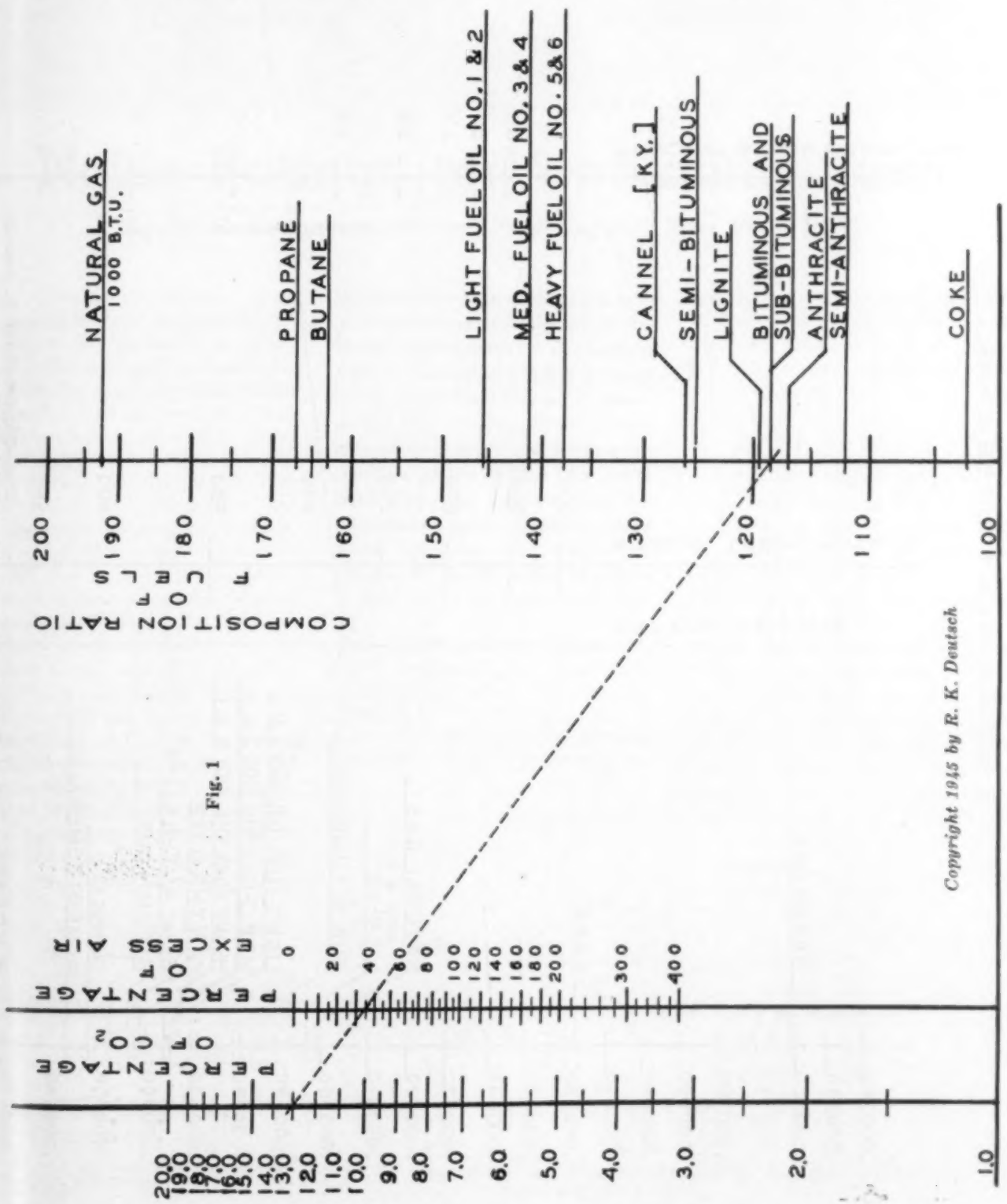
EXCESS AIR CHART
NATURAL GAS 1000 B.T.U.
PROPANE
BUTANE
LIGHT FUEL OIL NO. 1 & 2
MED. FUEL OIL NO. 3 & 4
HEAVY FUEL OIL NO. 5 & 6
CANNEL [KY.]
SEMI-BITUMINOUS
LIGNITE
BITUMINOUS AND SUB-BITUMINOUS
ANTHRACITE SEMI-ANTHRACITE
COKE
COMPOSITION RATIO OF FUELS
200 190 180 170 160 150 140 130 120 110 100
PERCENTAGE OF EXCESS AIR
0 20 40 60 80 100 120 140 160 180 200 300 400
PERCENTAGE OF CO_2
20.0 19.0 18.0 17.0 16.0 15.0 14.0 13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0

Fig. 1

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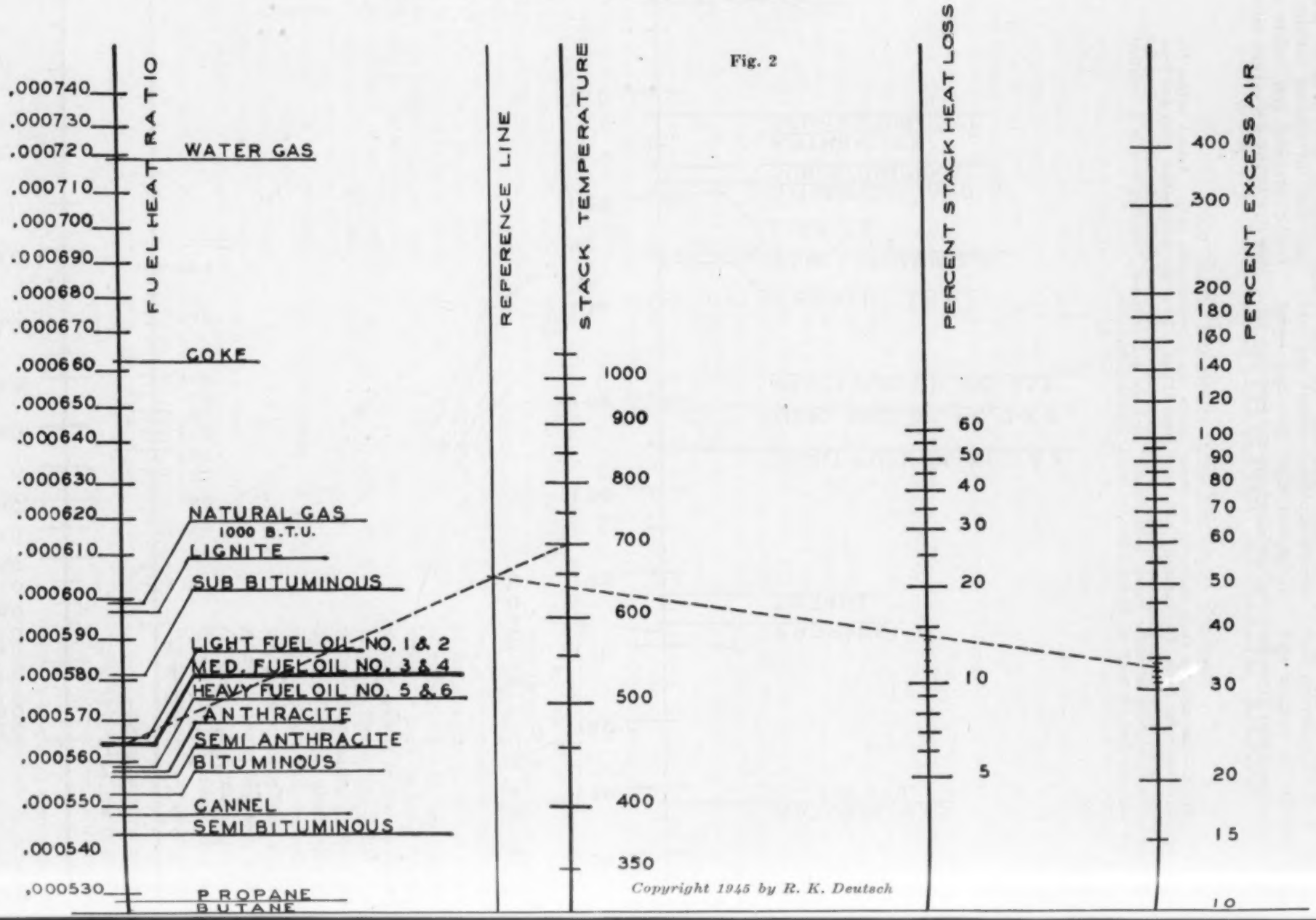
STACK HEAT LOSS CHART

Fig. 2



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Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Noise Ratings of Ventilating Fans

By W. H. Hoppmann, II* and Fred Lager,** New York, N. Y.

SUMMARY—Description of a special fan test room designed by the Navy Department for conducting tests to determine either the noise rating in decibels or sound power output (SPO) rating. Tests of centrifugal and axial fans having capacities up to 30,000 cfm have been run and indicate that the equipment and method used would produce data which appeared to be a valid measure of the merits of individual fans.

In ventilating systems, noise generated by fans is generally undesirable, but especially so in the case of Naval Vessels. Accordingly, in 1939 the Navy Department, in connection with its work to reduce noise levels on naval vessels, formulated a noise specification for ventilating fans. The testing technique described in the specification was subsequently adopted by the *National Association of Fan Manufacturers*, and in 1942 it was incorporated in their code entitled Sound Measurement Test Code for Centrifugal and Axial Fans.

Both in the *NAFM* Code and in the Navy Specification, the noise rating of the fan is defined as the arithmetical average of the sound levels at seven positions around the fan, as shown on Fig. 1. The position of the microphone at each station is required to be in a plane parallel to the floor and coinciding with the horizontal centerline of the fan.

Some investigators have considered that sound power output (SPO) would constitute a more satisfactory rating for ventilating fans. There are a number of points in favor of the use of this method of rating. It can serve for acoustical design as well as for specification purposes. It provides a more refined rating which is independent of the distances of the microphone from the fan, whereas the present method gives an average decibel rating which depends on the specific configuration of microphone positions used to determine it. However, it may also be useful to have a noise rating in a logarithmic scale, such as the decibel, because the ear response is nearly logarithmic.

An average decibel rating could be obtained from the SPO by computing for a chosen distance, the sound level which, if uniform over a hemisphere of radius equal to that distance, would give the acoustical power of the fan.

The test method used by the Navy and the *NAFM* does not differ essentially from the test method required in the determination of the SPO. In both cases sound levels are determined with standard me-

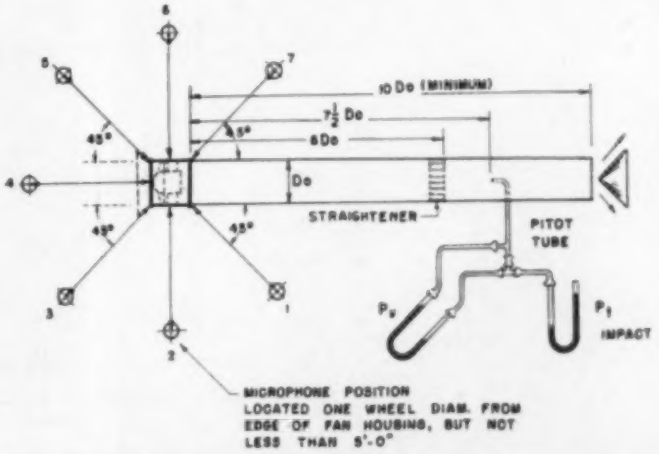


Fig. 1—Fan test arrangement used by the Navy Department and the NAFM

*Senior Mechanical Engineer, Material Laboratory, New York Navy Yard.
**Associate Mechanical Engineer, Material Laboratory, New York Navy Yard.
Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January 1945.

ters. The difference really lies in the method of calculation and possibly in the number and locations of microphone positions. In the case of the present specified method the sound levels are simply averaged arithmetically while in the SPO method the levels are operated on to evaluate the power.

A method of estimating sound power output is given as follows:[1] If a piece of equipment is radiating sound into an infinite medium, that is, into a medium in which no reflecting surfaces are present, the total output from the equipment can be obtained by measuring sound levels at a reasonably large distance from the source and at various points over a spherical surface of which the sound source is the center. The total power output will then be equal to the integrated components of the equivalent energy flux over the surface of a sphere.

For the case of a ventilating fan mounted on a hard floor, a hemisphere may be used on the assumption that all of the sound directed to the floor is reflected through the surface of the hemisphere. The hemispherical surface should be divided into suitable areas and the sound level measured in each area.

The SPO may then be obtained by a numerical integration or summation of the products of the power per unit area and area corresponding to each of the various sound level measurements.

A simple tabular form for the purpose of routine testing and rating can be set up so that sound level readings in decibels, ambient sound levels and acoustical power per unit area computed from the sound levels may be recorded. After the elementary calculations to convert the decibel readings into power per unit area are performed and allowances for ambient are made, the SPO may be readily computed.

It should be noted that if the ambient sound level is less than 10 decibels below the readings obtained with the fan operating, it is considered necessary to make an allowance for it.

It is not practicable at the present time to measure sound levels in the airstream in a duct connected to a ventilating fan, mainly because of the lack of a suitable device to measure reliably this portion of the radiated sound. However, since the present fan testing codes are mainly designed to evaluate fans on a relative basis with regard to noise, this point is not too serious. For more precise analysis and rating, provisions should be made to estimate the sound that is radiated into the duct.

It should be clear that for either method of evaluating the acoustical performances of a ventilating fan, a space approximating a free field is required. Since an infinite space with no reflecting surfaces is just an ideal concept and since, further, the use of quiet out-of-doors as an approximation is impracticable because of weather and other conditions, it is highly desirable to provide a soft standard room for test purposes. It is essential for the SPO method and in the case of the method prescribed in Navy specification and *NAFM* Code, it would serve to eliminate controversies about results obtained in different spaces.

On the basis of the experience that the Navy has gained in the testing of ventilation fans for noise characteristics, it has now designed and built a special fan test room to which the remainder of this paper will be devoted.

The primary factors influencing the design, and particularly the size, of the fan test room, were the Laboratory space available and the cost of construction. On the one hand, the size and shape of the fan test room were governed by the 20 ft spacings of the concrete columns of the Laboratory building, and on the other hand, it was necessary that the room be at least large enough to encompass the largest test fan with sufficient room for microphone measurements. In addition the room had to be isolated from vibrations of the floor on which the room is set, acoustically treated with sound absorbing material to reduce the sound wave reflections in the room, and insulated to reduce the transmission of external noise into the room. The acoustical insulation, however, which must be capable of insuring ambient noise levels of 68 db or lower in the room, had to be maintained in spite of the fact that the nature of the test requires several relatively large openings in the room; a large low velocity, air intake and a smaller opening for the discharge duct from the test fan. A door was also provided for access. With indoor Laboratory space available for the construction of the fan test room, weatherproofing was not a consideration in the de-

[1]Applied Acoustics by Olson and Massa.

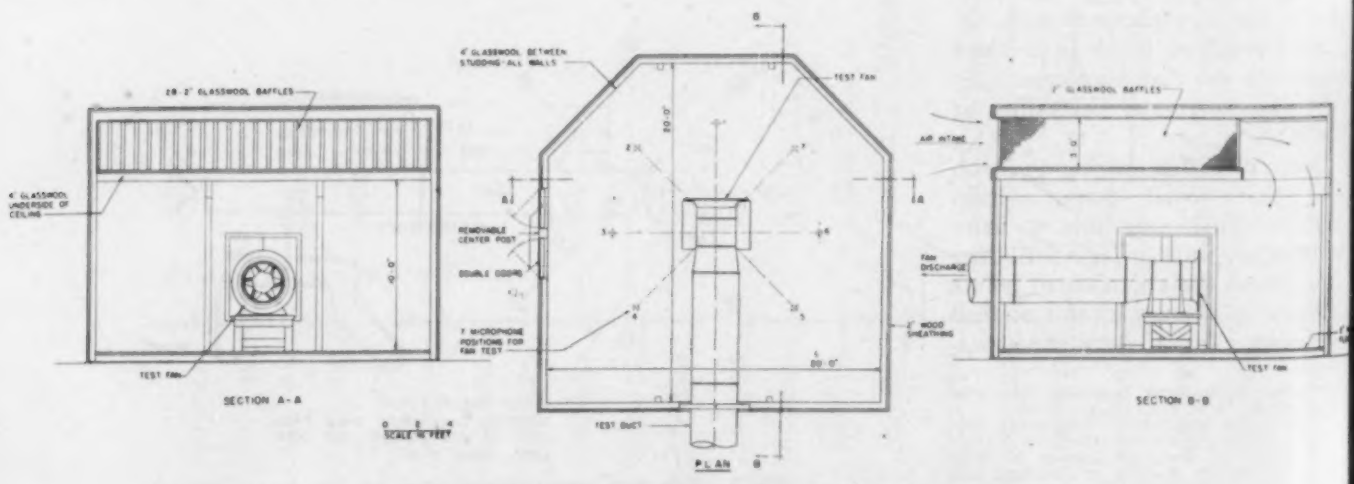


Fig. 2—Plan and sectional elevations of fan test room

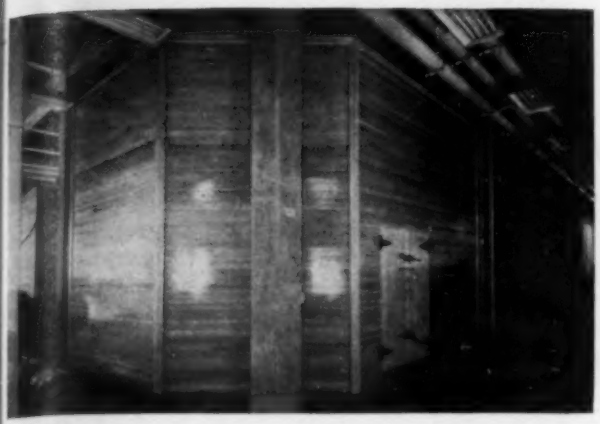


Fig. 3—Exterior view of rear and side of fan test room

Fig. 4—Interior of fan test room looking toward removable duct panel

sign and the room as constructed by the Navy is not intended for outdoor construction.

The maximum interior dimensions of the fan test room are 20 ft wide by 20 ft long by 10 ft high, exclusive of a 3 ft high by 20 ft wide air intake in the upper portion of the structure, as shown in Fig. 2. This provides sufficient space to test the largest Navy ventilating fans, including space required for microphone measurements. The irregular hexagonal shape of the room was governed largely by the 20 ft center to center spacings of the concrete columns of the laboratory building in which the fan test room is located. The asymmetry of the structure, however, is also of some value in reducing the standing wave pattern that occurs in the room during a test of a fan.

Wood construction was used for the fan test room in preference to steel, brick or concrete, because of the ease of construction, reduced weight, and lower cost. Heavy wood framing, covered externally with two layers of tongue and groove sheathing, separated by double thickness of heavy asphaltic paper was used for the walls and roof. The upper surface of the intermediate ceiling, the underside of the roof and the floor, were similarly constructed. Floor joists, roof beams, ceiling beams, ceiling girders and girder posts were also constructed of wood. Fig. 3 shows a photograph of the exterior of the fan test room.

Since the boundary surfaces of the test room greatly affect the sound level in the room due to the number of reflections of the sound waves from these surfaces, the interior of the walls and the underside of the ceiling were acoustically treated by covering them with four inch thick fiberglass over which were spread two layers of muslin and wire mesh. The glass wool in blankets was placed between the 4 in. studding of the walls and between the ceiling joists. No acoustical treatment was applied to the floor. A photograph of the interior of the room is shown on Fig. 4.

A low ambient noise level is important in a room for noise testing. In order to accomplish this for the fan test room, with the type of wood construction used, the two layers of tongued and grooved, wall and roof sheathing, were tightly fitted and end matched, with the joints staggered. The two ply asphaltic paper used between layers of wood sheathing was continuously lapped around the structure in order to keep air leakage and accompanying air borne noise at a minimum. Wood draft stopping and caulking were used at the intersection of walls, ceiling, and roof, to eliminate the possibility of air borne noise entering the room. However, a large air intake is essential for fan testing, and it was necessary to treat this intake acoustically to absorb the noise coming in from outside of the room, and insure a low ambient noise level within. The air intake to the room is a 3 ft high by 20 ft wide channel

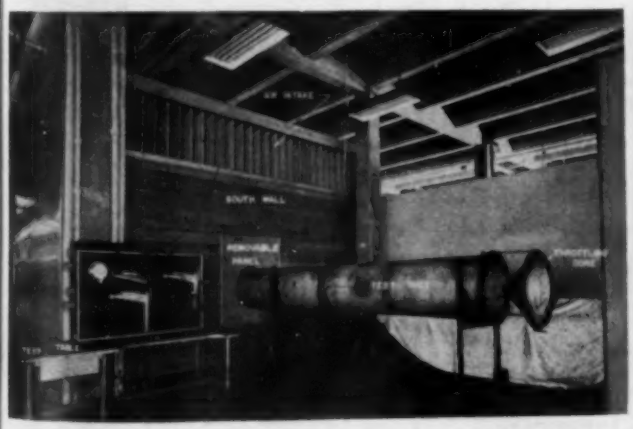


Fig. 5—Exterior view of fan test room showing air intake and removable duct panel

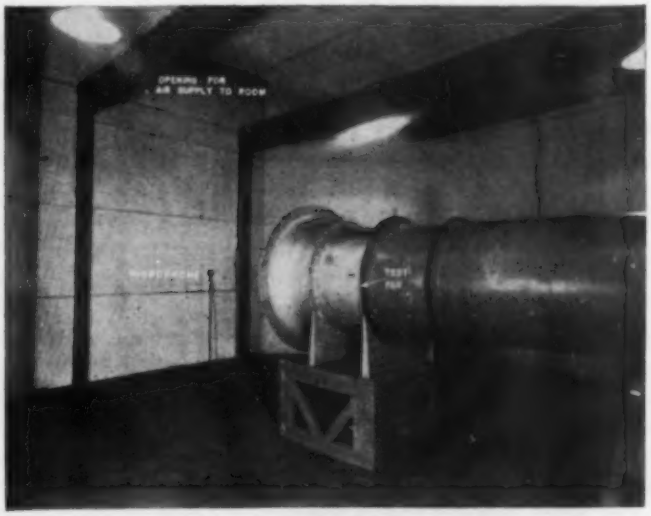


Fig. 6 (right)—Interior of fan test room looking toward discharge of air intake

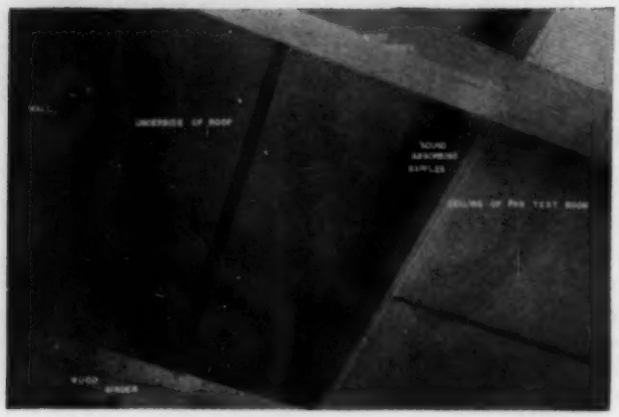


Fig. 7—Interior of room showing discharge of air intake (looking upward)

containing 28 baffles, approximately 14 ft long and 3 ft high, of wood frames containing 2 in. of glass wool, covered both sides by muslin and wire mesh. The space between adjoining baffles is 6 in. clear and the free area of the air intake is approximately 72 per cent. Photographs of the air intake are shown on Fig. 5 and Fig. 6. The discharge of the air intake in the room is shown on Fig. 7.

The other two openings in the fan test room, one for the discharge duct and one for access to the room, were insulated against noise transmission from the outside, by providing means for closing the openings during a fan test. The discharge duct opening in the room is a steel framed opening provided with several pairs of 2 in. thick, tongued and grooved, removable panels, each pair of which is cut to fit a different size of circular test duct. The pair of panels shown on Figs. 4 and 5, is bolted to a felt lined angle iron frame after the test duct is in position. The entrance to the room is through a pair of 2 in. thick wood doors, provided with dog clamps which, when closed, force the doors against a continuous wood and piano felt doorstop and gasket, and so provide reasonably airtight and soundproof doors. The center post of the door frame is removable for the access of the large fans.

The fan test room is provided with electric lights and power outlets on the walls, which were so made that there is no rigid conduit connection between the room and the power source. Where it was necessary to pierce the walls, floor, ceiling or roof, flexible conduit was used and the spaces around the conduit were plugged and caulked.

Isolation of the fan test room from vibrations of the foundations on which it is built is essential to insure both low ambient noise levels in the room and reliability of the test results. One inch hairfelt placed between the concrete floor of the laboratory building and all bearing surfaces of the Navy room, was satisfactory. However coiled springs or commercial types of vibration eliminators would have to be used, if the floor vibrations were of such amplitude and frequency as to make the 1 in. hairfelt ineffective.

The determination of the sound wave pattern or the presence of standing waves in the room at frequencies predominant in ventilation fans would indicate the acoustical value of the room for fan testing. Fig. 8 shows the results of a sound survey at various distances from a non-directional loudspeaker unit on which was impressed both warbled and pure frequencies. Also shown on Fig. 8 is the curve of variation of sound level of a fan with microphone distance from the fan. For comparison, there is superimposed on this curve the theoretical curve for free field conditions, drawn through the point representing the microphone position closest to the fan. It should be noted that part of the deviation is attributable to the fact that the fan is not a point source, while the theoretical curve for free field conditions is based on a point source. The most pronounced wave pattern was obtained with the single frequency sounds as compared to the warbled frequencies and the many frequencies of the fan. This would be expected if certain of these single frequencies were identical with the natural frequencies of the air mass of the room. In general the standing wave pattern in the

Fig. 8—Sound survey of fan test room

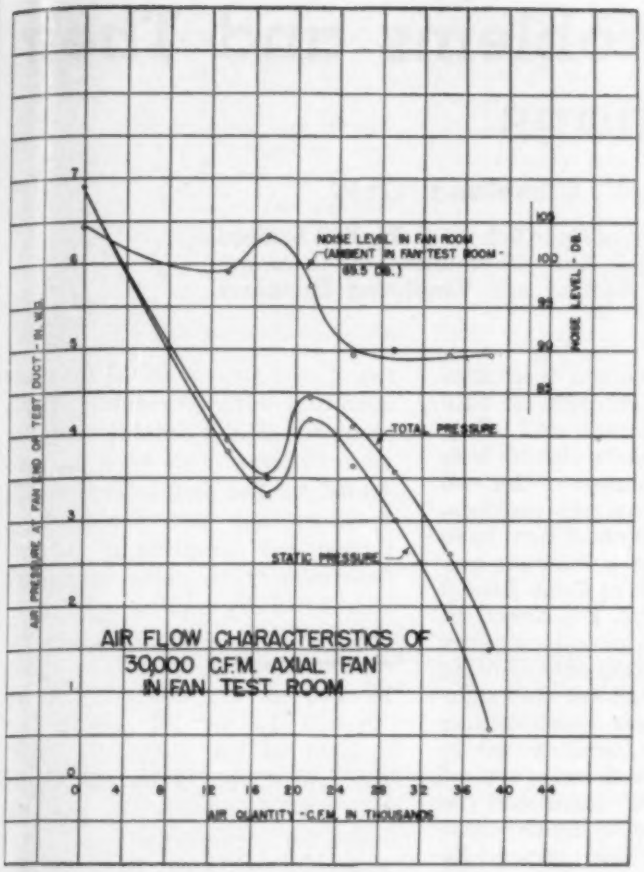

NOISE LEVEL IN FAN ROOM
(AMBIENT IN FAN TEST ROOM - 68.5 DB.)
TOTAL PRESSURE
STATIC PRESSURE
AIR FLOW CHARACTERISTICS OF
30,000 C.F.M. AXIAL FAN
IN FAN TEST ROOM
AIR PRESSURE AT FAN END OF TEST DUCT - IN. W.G.
NOISE LEVEL - DB.
AIR QUANTITY - C.F.M. IN THOUSANDS

Fig. 9—Air flow characteristics of 30,000 cfm axial fan in fan test room

room is of small amplitude so that it will not introduce any appreciable error in the noise measurements in the fan test room.

The determination of the sound transmission loss through the room would indicate the effectiveness of the room in attenuating external noise and the ambient noise levels that could be expected in the room. This was done, with a fan and duct in test position in the room, by generating a high uniform noise level of 89 db outside of the room and measuring the noise levels inside the room. It was found that the room attenuated 14 db and that an ambient noise level of 68 db can be obtained in the room when the Laboratory is at normal operation.

The noise generated by the fan will vary with the air flow pattern in the fan test room, and the air flow pattern will vary, depending on the location of the fan in the room. Tests were conducted to determine both the effect of the fan location on the noise generated by the fan, and the best position of the fan for test. By smoke flow tests, air flow measurements, and by determining the noise performance curve of fans at many locations in the room, it was found that the most stable air flow condition, least turbulence, and best performance, were obtained with the fans in the center of the room. Axial fans were found to be much more sensitive to the air flow pattern in the room than were centrifugal fans.

The original room built by the Navy was provided with an intake located at the end of the room opposite the fan duct discharge. The *S* shaped path of the air from outside the room to the fan inlet resulted in air turbulence and unreasonably high noise levels generated by the fan. The present modified room now has the air intake at the same end of the room as the discharge duct, the air following a *U* shaped path from outside the room to the fan inlet, resulting in more stable air flow conditions in the room and subsequent lower noise levels generated by the fan. At the discharge of the air intake to the room, many arrangements of splitters, vanes, deflectors and splash plates were tested to determine the effect on the noise generated by the fan. Although the use of vanes and splitters resulted in a better distribution of the air across the discharge of the air intake, no improvement in fan performance was observed and the additional expense of a permanent installation did not seem warranted.

Both centrifugal fans and axial fans up to 30,000 cfm have been tested in the fan test room, for both airflow performance and for noise. The data obtained appeared to be a valid measure of the merits of the individual fans. Typical performance curves are shown on Fig. 9, and were obtained in testing a 30,000 cfm axial fan. The maximum pressure loss across the room was 0.145 in. water at 38,000 cfm for the axial fan rated at 30,000 cfm at 3.0 in. water.

The largest fan tested in the fan test room was the 30,000 cfm axial fan, 45 in. in diameter, and 52 in. long, exclusive of the inlet bell mouth, and the room provided ample space for the seven microphone positions specified in the Code.

One of the most important advantages of the fan test room for fan testing is that it is reproducible and allows for standardization of the test space. In the past spaces for testing fans for noise have been defined only in general terms with a general requirement that they approximate free field. However, fan testers, while conforming to the specification in this respect, may obtain different results with the same fan tested in different spaces due to space effects. It is highly impracticable to endeavor to compute or correct for these effects. The fan test room is an attempt to eliminate controversial space effects encountered in fan testing and to provide a means of further standardization of fan test methods.

Acknowledgment is made to Capt. T. H. Urdahl, USNR, for his sponsorship of the ventilating fan testing room for the Navy Department; to Lieut-Comdr. H. M. Gurin, USNR, for his constructive criticism and encouragement during the work; to John Lind, Principal Materials Engineer, Material Laboratory, New York Navy Yard, under whom the test room for the noise rating of fans was designed and built; and to the authors' associates in the Material

[*Concluded on Page* 104]

Air Cooling Coil Problems and Their Solutions

By Lawrence G. Seigel*, Cleveland, Ohio

This paper is a result of research work at Case School of Applied Science, at the instigation of the Bureau of Ships, Navy Department and in cooperation with the American Society of Heating and Ventilating Engineers.

SUMMARY—A method of calculation based upon separate (or film) coefficients for air-side and refrigerant-side surfaces is offered here as a practical solution to the coil rating and performance problem. This Humidity Method has been developed during a ten-year program of research at Case School of Applied Science. It is based on the results of tests of coils of many different designs and of coils using both direct expansion and non-volatile refrigerants. The flexibility of the method is demonstrated by a group of figures showing typical coil performance calculated for various conditions, using the equations given in this paper. Examples of the use of the method are given in the Appendix.

COOLING coil problems have been solved, for the most part, by overall performance factors patterned after those in use by the heating industry for the purpose of rating steam coils and unit heaters. This method of coil rating has proved fairly satisfactory for use with air cooling in which no dehumidification takes place, but when moisture from the air stream is deposited on a coil surface, the use of overall coefficients is either inaccurate or becomes involved. A method based upon separate (or film) coefficients for air-side and refrigerant-side surface is offered here as a practical solution to the coil rating and performance problem.

Introduction

This method has been developed during a ten-year program of research at Case School of Applied Science and is based on the results of hundreds of tests of many different coil designs and on coils using both direct expansion and non-volatile refrigerants. It provides a simple means for obtaining manufacturers' rating data which requires only a few tests for each design of coil, and it affords a basis of calculation of coil performance which gives direct results for any desired conditions without trial and error and without the use of many pages of tables that involve tedious interpolation.

The basis for this *Humidity Method* was presented to the ASHVE in a paper in 1938.[1] At that time, however, the method had not been fully developed, and the data reported were the results of tests on water coils only. As several hundred additional tests have been run it is the purpose of this paper to demonstrate how the method previously outlined has been simplified, and how it can be applied to either the rating or the selection of any type of finned coil operating under conditions of forced convection.

Coil Performances

In the paper already mentioned, a mathematical derivation was presented which defined the locus of exit air conditions for a coil operating with decreasing surface temperature and constant entering air conditions. This locus is represented by the line 1-2-3-4 in Fig. 1, which has been drawn for a typical coil operating at a given face velocity. A point on line 1-2 represents dry cooling only, and a point on line 2-3-4 indicates that dehumidification has taken place, as well as dry cooling. A line through 1-3 or 1-4 will be recognized as the commonly known load ratio line, while the curved line 1-M represents the condition curve for a particular condition of operation. It should be understood that the line 1-2-3-4 is not intended to indicate anything about the condition of the air as it passes *through* the coil from row to row. It simply represents on the psychrometric chart the possible location of the condition of the air as it *leaves* a coil operating with decreasing refrigerant (or surface) temperature. Condition curves similar to 1-M can be constructed through the use of the *Humidity Method* if they are de-

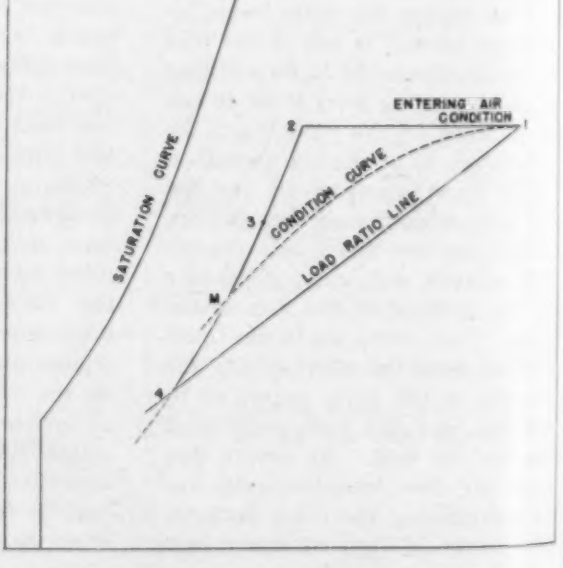


Fig. 1 — Psychrometric layout showing coil performance

*Instructor in Mechanical Engineering, Case School of Applied Science. Member of ASHVE.

[1]Performance of Surface-Coil Dehumidifiers for Comfort Air Conditioning, by G. L. Tuve and L. G. Seigel. (ASHVE Transactions, Vol. 44, 1938, p. 523.)

Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January 1945.

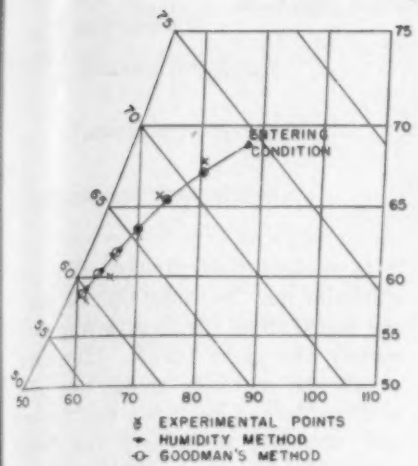


Fig. 2—Comparison of methods for determining condition curves

sired, and for purposes of illustration Figs. 2 and 3 have been prepared. These show a comparison of condition curves determined by Goodman's method and by the *Humidity Method*. The test data and coefficients used were obtained by Goodman.[2] In one case, as shown in Fig. 3, the coil surface was only partially wet and still fairly good agreement is demonstrated. However, these curves are usually not required in practice since the main concern is not what happens to the air as it passes through the coil, but what its condition is *leaving* the coil.

The line 2-3-4 in Fig. 1 has been established as a line at a constant horizontal distance from the saturation curve on the psychrometric chart. This line has been established mathematically in the 1938 paper[3] and data from many actual tests are available to provide further proof. Fig. 4 shows the results of one such test. To obtain the data of Fig. 4, air at a condition represented by point A was constantly supplied to a four row coil and the coil surface temperature was lowered by reducing the refrigerant temperature in such steps as were required to obtain points B through G. At point G, the refrigerant temperature was below the freezing point of water, and the test was stopped to prevent frosting of the coil. However, it is doubtful if a coil operating with a frosted surface would produce air any closer to the saturation curve than indicated by the points of Fig. 4. In support of this statement, the results of a test made with frosted coil surface are offered in Fig. 5. Although the points are not so consistent as those in Fig. 4 (due to the difficulty of testing under frosted conditions), it is still evident that the exit conditions do not approach the saturation curve. Many tests like that shown in Fig 2 have been made. Therefore, in view of the mathematical derivation and the supporting experimental evidence, it seems safely established that the locus of the exit air conditions for a coil operating with constant entering conditions and decreasing refrigerant temperature is a line similar to line 1-2-3-4 of Fig. 1. Actually, when the exit conditions for a coil are partially located by the use of such a line, every coil problem (whether moisture is condensed or not) becomes a dry cooling problem which involves only sensible heat coefficients. Hence, the problem is not complicated by wet coil multipliers or the use of different coefficients for wet and dry surfaces, or by the determination of the relative portions of wet and dry surface.

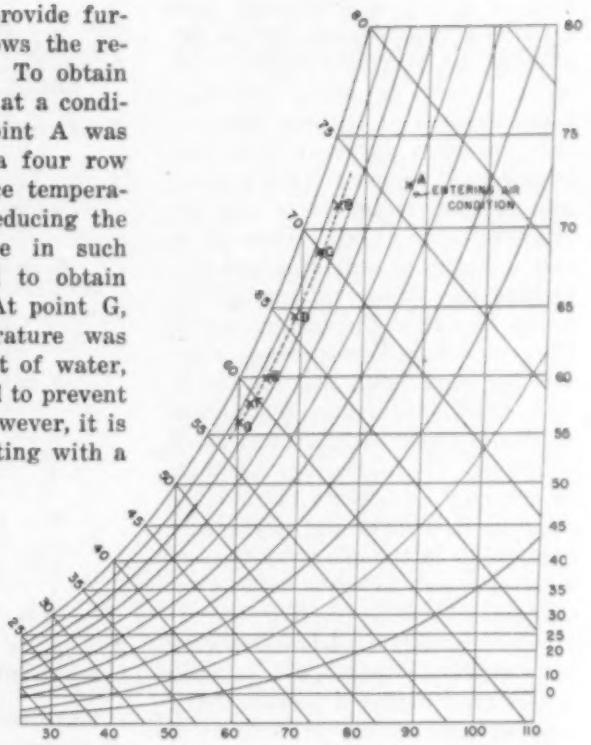


Fig. 4—Air conditions leaving coil operating at constant entering condition and decreasing refrigerant temperature

It will be noted that mention of refrigerant temperature has been omitted from the foregoing discussion. This is because the perform-

[2]Dehumidification of Air with Coils, by William Goodman. (*Refrigerating Engineering*, October, 1936.)
[3]Loc. Cit. Note 1.

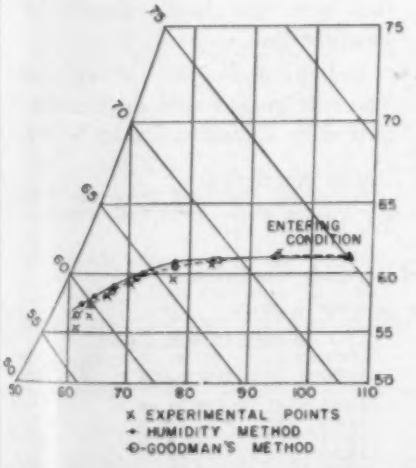


Fig. 3—Comparison of methods for determining condition curves

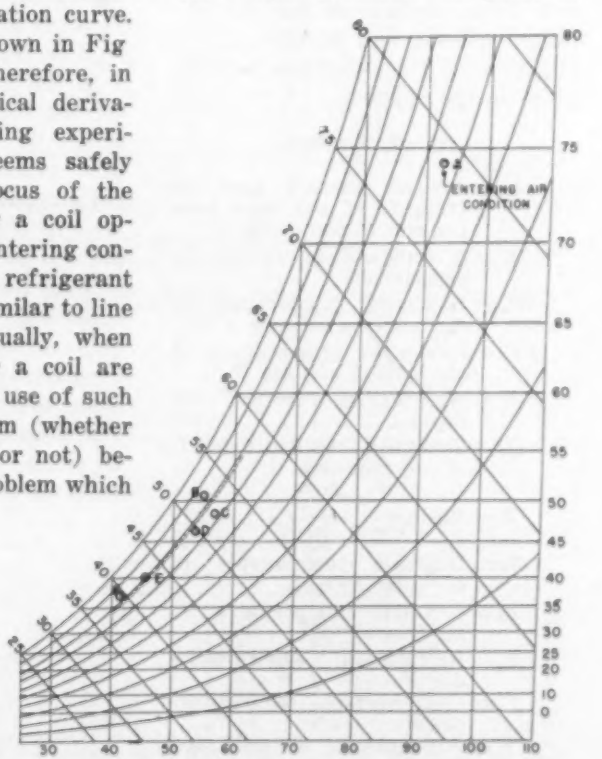


Fig. 5—Air conditions leaving coil operating at constant entering condition and decreasing refrigerant temperture and frosted surface

ance of a coil is dependent upon air-side characteristics and is not affected by refrigerant-side variables except as these variables cause changes of surface temperature. In other words, it is possible to select the proper coil for a given job without reference to the refrigerant-side at all. Then it is only a matter of providing and controlling the proper refrigerant capacity to obtain the desired result. This is a definite advantage since air-side coefficients may be fairly well established while refrigerant coefficients may be subject to much variation. That is to say, the proper coil may be selected in any case from air-side data and any errors that result in the compressor selection (due to inaccurate data on refrigerant coefficients) may be corrected relatively easily by changing the compressor speed. This is much better than having a possible error carried over to the air-side as it would be by any method based on over-all coefficients.

Coil Calculation Equations

In the use and application of the *Humidity Method*, only three simple equations and a psychrometric chart are necessary. These equations which are given in Table 1 involve the knowledge of two surface coefficients which must be obtained from test. A discussion of how these coefficients may be obtained follows, and samples of application of the equations will be given in the appendix.

List of Symbols

A_s = Air-side surface area, sq ft/sq ft of coil face area per row of coil depth.
C = A constant determined by experiment.
DP_1 = Dew-point temperature of air entering coil deg F.
DP_2 = Dew-point temperature of air leaving coil deg F.
N = Number of rows of coil depth.
Q_t = Total coil load Btu/hr/sq ft of coil face area.
R = Ratio, $\frac{T_1 - DP_1}{T_2 - DP_2}$
T_1 = Dry-bulb temperature of air entering coil.
T_2 = Dry-bulb temperature of air leaving coil.
T_r = Refrigerant temperature deg F.
T_s = Coil surface temperature deg F.
V = Air velocity at coil face, ft/min.

Table 1—Coil Calculation Equations

No.	Equation	Normal Use
1.	$\frac{h_s A_s N}{0.243\, G_a} = \log_e \frac{(T_1 - DP_1)}{(T_2 - DP_2)} = \log_e R$	Exit cond. location
2.	$T_s = \frac{(RT_2 - T_1)}{(R-1)}$	Surface temperature
3.	$Q_t = \frac{h_r}{R_s} A_s N\,(T_s - T_r)$	Refrigerant temperature

G_a = Weight of air-vapor mixture lb/hr/sq ft of coil face area.
G_{da} = Weight of dry air lb/hr/sq ft of coil face area.
h_1 = Enthalpy of air-vapor mixture entering coil, Btu/lb of dry air.
h_2 = Enthalpy of air-vapor mixture leaving coil, Btu/lb of dry air.
h_s = Air-side film coefficient, Btu/hr/sq ft/deg F.
h_r = Refrigerant film coefficient, Btu/hr/sq ft/deg F.
n = A constant determined by experiment.

Surface Coefficients

Air-Side Coefficients: Since heat is transferred from air to a cooling coil by means of a difference in temperature between the air and the coil surface, it is clear that the performance of the coil is dependent upon the air-side characteristics of the coil only and is not affected by the type or kind of refrigerant used except as the refrigerant affects the surface temperature of the coil. These air-side characteristics then should be obtained most satisfactorily by use of air-side data alone. This may be done by application of Equation 1 to the results of wet coil tests, solving for h_s. If values of h_s obtained by use of this equation are then plotted against air velocity, the air-side coefficient will be evaluated in a form which may be expressed by the equation $h_s = CV^n$.

Many other ways of finding these coefficients have been suggested. Some of these have been tried for comparison purposes using the same test data for the same coil. The results are indicated in Table 2, which shows serious disagreement in only one case. Therefore, it is evident that air-side film coefficients may be obtained in various ways, all of which give approximately the same result. However, of all the methods tried, the *Humidity Method* required the fewest and simplest tests and the least complex calculations. The methods of Table 2 are as follows: (1) Goodman Method,[4] (2) Variation of BCMI Method,[5] and (3) Humidity Method.

To obtain surface coefficients by the *Humidity Method*, only three wet coil tests are required. However, this is the minimum number, and for the purpose of checking, it is recommended that at least six be run. The only requirements are that the coil be operating under dehumidifying conditions, and the air velocity be varied by at least three values in the range in which the results are to be applied. It does not matter if the surface of the coil is entirely wet or only partially wet. However, extremely light latent loads are very difficult to determine, and therefore it is recommended that tests having sensible to total load ratios of less than 70 per cent be used. To evaluate the coefficients from the test data, it is only necessary to solve Equation 1 for h_s and then plot this coefficient against the air velocity which prevailed during the test. If log-log paper is used for this plot, the result should be a straight line.

Refrigerant-Side Coefficients: The refrigerant-side coefficients required by Equation 3 may be evalu-

[4]Loc. Cit. Note 2.
[5]Proposed Standard Code for Testing Air Cooling Coils, *Blast Coil Manufacturer's Institute*, 1942.

Table 2—Comparison of Air-Side Coefficients

(Calculated by three different methods)

Test	Total Load Btu/hr	Air Flow #/hr	Air-Side Coefficient h_s Goodman Method	BCMI Method	Humidity Method
31	92,900	8760	18.65	19.10	18.42
32	80,750	6600	13.22	12.71	12.85
33	64,000	4590	9.38	9.04	9.03
34	96,200	8650	16.85	15.00	15.78
37	77,650	4650	9.92	9.60	9.35
38	121,400	10800	19.18	15.40	19.26

Table 3—Comparison of Refrigerant-Side Coefficients

(Calculated by two different methods)

Test	Total Load Btu/hr	Air Flow #/hr	Refrigerant Coefficient h_r Goodman Method	Refrigerant Coefficient h_r Humidity Method
31	92,900	8760	235	332
32	80,750	6600	341	315
33	64,000	4590	360	321
34	96,200	8650	287	356
37	77,650	4650	300	378
38	121,400	10800	316	390

ated from the same test data that were used for the determination of the air-side coefficients simply by the application of Equations 2 and 3. These coefficients will be quite erratic because of many factors such as variations in oil quantity, mean temperature difference, and refrigerant properties. To illustrate this variation and to demonstrate that it is independent of method, Table 3 has been prepared to show refrigerant coefficients calculated by two different methods for the same test data. The fact that the same proportional variation does not occur in the results of these methods probably indicates that a large part of the error is due to differences in determining the mean temperature difference between the surface and the refrigerant. More research is required on this subject, and one project is already started under the sponsorship of the ASHVE. However, in spite of the erratic nature of these refrigerant coefficients, serious errors in coil selection will not result since the selection of the coil itself is based on air-side data. The selection of the refrigerant compressor may be slightly in error, but this will seldom be serious if the coefficients were evaluated under typical operating conditions.

Accuracy of Humidity Method

If the equations of Table 1 are used for the solution of coil problems, air-side performance may be predicted well within the limits of accuracy of psychrometric determinations. Refrigerant-side performance (*i.e.*, refrigerant temperature) may be predicted within about two degrees suction temperature, which is within the tolerance of most commercially obtainable freon 12. Evidence of these statements is given in Tables 4, 5, and 6, which show a comparison of predicted coil performance vs. actual performance obtained by test. Table 4 shows results for a plate fin coil; Table 5, for a spiral fin coil; and Table 6, for a plate fin coil on which no rating tests were run. That is, the coil used to obtain the results of Table 6 was built according to certain specifications, and the performance was predicted simply from a knowledge of the entering air conditions, the air quantity, and the required load ratio.

The actual procedure by which the data of these tables were obtained is as follows: For Tables 4 and 5, coil rating tests were run to determine h_a and h_r. Then through the use of these coefficients and the equations of Table 1, coil performance was calculated for certain specified conditions of entering air temperature, air quantity and refrigerant temperature. These conditions are indicated in the tables as *predicted values*. After these predictions had been made, tests were run to verify the calculated performance. The results of these tests are shown in the tables as

Table 4—Prediction of Coil Performance[a]

(6 Row Plate Fin Coil)

No.	D.B. In		W.B. In		D.B. Out		W.B. Out		T_r		Load-Btu/hr		# Air/hr	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
1	80.0	80.38	75.0	75.24	64.0	64.11	63.3	63.34	52.23	50.30	70,416	75,630	7260	7570
2	90.0	89.96	75.0	74.92	65.9	65.90	64.0	64.04	53.48	52.70	66,600	67,200	7260	7430
3	100.0	99.62	78.0	77.79	67.2	67.03	64.4	64.29	50.62	50.38	85,752	84,390	7260	7330
4	100.0	100.1	75.0	75.08	68.0	68.26	64.65	64.74	54.67	54.85	63,216	62,875	7260	7390
5	80.0	80.1	67.0	67.0	57.75	57.98	56.0	56.26	47.0	46.2	55,420	57,300	7260	7660

[a]Actual temperatures shown in the table are each the average result of 100 individual thermometer readings taken during equilibrium conditions at 5-min intervals for a period of 2 hours.

Table 5—Prediction of Coil Performance[a]

(5 Row Spiral Fin Coil)

No.	D.B. In		W.B. In		D.B. Out		W.B. Out		T_r		Load-Btu/hr		# Air/hr	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
1	90.0	90.30	75.5	75.57	69.3	69.55	65.2	65.23	52.5	52.5	69,826	70,660	7990	8090
2	80.0	80.56	73.0	72.77	64.6	65.35	62.7	62.71	49.8	48.97	65,882	66,100	7990	8165
3	105.0	105.30	76.7	76.67	72.4	72.84	64.5	64.50	48.0	48.04	82,922	80,930	7990	7905
4	100.0	100.19	78.2	78.23	72.8	72.89	66.7	66.67	50.9	50.42	81,504	81,310	7990	7970
5	100.0	100.18	78.0	78.43	75.9	75.95	69.6	69.60	57.9	56.70	61,540	64,620	7990	7910
6	85.0	85.04	71.0	71.02	64.8	65.18	61.0	61.01	48.5	48.17	61,230	60,830	7990	7955

[a]Actual temperatures shown in the table are each the averaged result of 100 individual thermometer readings taken during equilibrium conditions at 5-min intervals for a period of 2 hours.

Table 6—Comparison of Coil Performance[a]

(3 Row Plate Fin Coil)

No.	Ent. Air Cond. D.B.	Ent. Air Cond. W.B.	Air Flow #/hr	Load Ratio S/T	Exit Conditions By Test D.B.	Exit Conditions By Test W.B.	Exit Conditions Calculated D.B.	Exit Conditions Calculated W.B.	Total Load Btu/hr By Test	Total Load Btu/hr Calc.	Refrig. Temp. deg F By Test	Refrig. Temp. deg F Calc.
1	103.25	85.29	7680	0.628	83.19	77.97	83.15	77.90	59720	59800	57.9	58.0
2	90.12	75.06	7750	0.832	74.52	69.99	74.35	69.92	35320	35300	52.9	57.6
3	90.31	76.86	7620	0.559	70.82	67.26	70.99	67.33	64590	64000	48.0	45.1
4	90.20	74.87	7950	0.918	75.58	70.46	74.80	70.20	32890	35100	58.9	58.2
5	84.22	73.15	4052	0.520	62.25	60.01	62.25	60.01	41560	41560	46.9	44.1
6	85.51	71.18	7800	0.647	64.36	60.68	65.10	61.12	61940	59900	35.7	39.5
7	63.51	58.63	8020	0.575	53.99	52.29	53.60	52.02	29780	30900	44.5	39.8
8	90.32	75.39	5663	0.652	70.35	66.72	70.51	66.80	42160	42000	51.5	51.5

[a]Test temperatures shown in the table are each the averaged result of 100 individual thermometer readings taken during equilibrium conditions at 5-min intervals for a period of 2 hours.

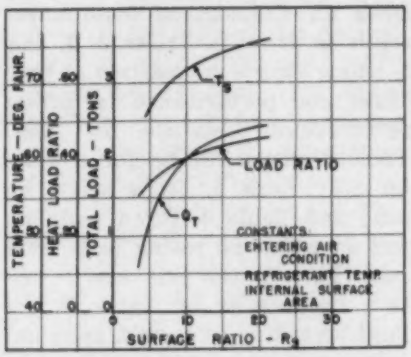


Fig. 6—Effect of surface ratio on coil performance

actual values. In many cases the difference between the calculated and actual load can be traced directly to the inability to set the air quantity exactly at the required *predicted* value.

For Table 6 the procedure was somewhat different. No rating tests were run on this coil. But the coefficients had been previously determined for a similar coil design of different depth (6 rows) built by the same manufacturer. Therefore, to test the accuracy of the *Humidity Method*, especially in respect to effects of coil depth, the *calculated* values of Table 6 were determined. To obtain these *calculated* values, the entering air conditions, air quantity, and load ratio taken from tests on the three row coil were selected as *given* data, and exit air conditions, refrigerant temperature, and total load were calculated by use of the coefficients of the *six* row coil and the equations of Table 1. These *calculated* results were then compared with the actual test results as shown in Table 6.

It is evident from an examination of these tables that air-side accuracy is much more satisfactory than refrigerant-side accuracy.

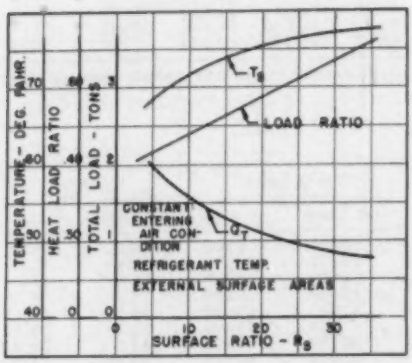


Fig. 7—Effect of surface ratio on coil performance

However, before refrigerant-side accuracy can be improved, much more research is needed on refrigerant coefficients and more control is required on refrigerant properties so that these properties will agree with published data.

Adaptability of the Humidity Method

Although simplicity and accuracy are two important features of the *Humidity Method*, its general adaptability is no less an advantage. This adaptability permits the direct solution of many problems which are extremely difficult and

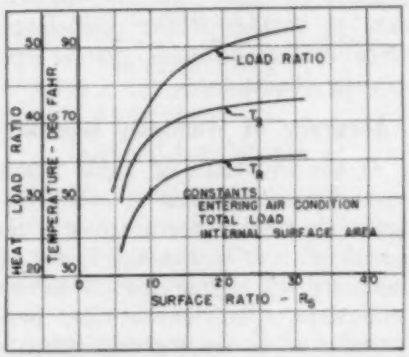


Fig. 8—Effect of surface ratio on coil performance

tedious by other methods. The problem of high latent loads when there is no intersection of the load ratio line with the saturation curve is one such example which is worked out in the Appendix. In order to illustrate further the general application of the *Humidity Method*, the effect of various factors on the performance of dehumidifying coils has been plotted in Figs. 6 through 17. These curves are the results of many calculations made by K. C. Garman.[6] All the data for constructing these curves were obtained only through the use of the three equations given in Table 1. These curves do not represent test results and are not for any particular coil. They are simply based on calculations to demonstrate typical coil performance.

Application of Humidity Method to Dry Cooling

Dry cooling problems are just as simply solved by the *Humidity Method* as by any other method.

[6]Factors Affecting the Performance of Direct Expansion Coils in the Cooling and Dehumidification of Air, by K. C. Garman. (Thesis, Case School of Applied Science, 1944.)

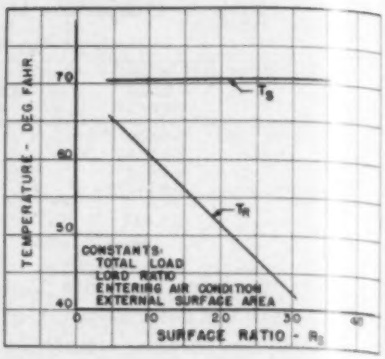


Fig. 9—Effect of surface ratio on coil performance

Since for dry cooling the initial and final dew-points are equal, the value of the fraction $(T_1 - DP_1) \div (T_2 - DP_2)$ loses its significance and should not be used. However, the value of R calculated from Equation 1 still applies, and the surface temperature and refrigerant temperatures may be calculated from Equations 2 and 3 in exactly the same manner as for cooling in which dehumidification takes place. The only limitation of the humidity method regarding dry cooling and dehumidification is that rating tests must be run with the coil dehumidifying. That is to say, the constants h_a and h_r must be determined from wet-coil tests. But once these constants have been determined for a particular coil design, they may be applied equally well to determine coil performance for either dry-cooling or dehumidification.

Conclusions

Based on an examination of the curves given in Figs. 6 through 17 and upon other data given in the paper, the following general conclusions can be drawn:

1. Accurate coil rating and selection may be accomplished on the basis of three simple equations; and the constants (h_a and h_r) required for these equations may be obtained from a minimum number of simple

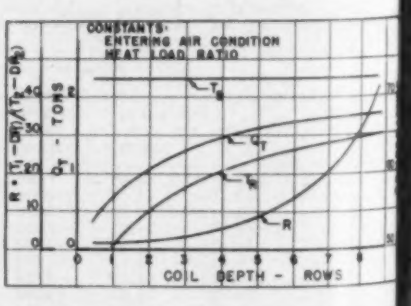


Fig. 10—Effect of coil depth on coil performance

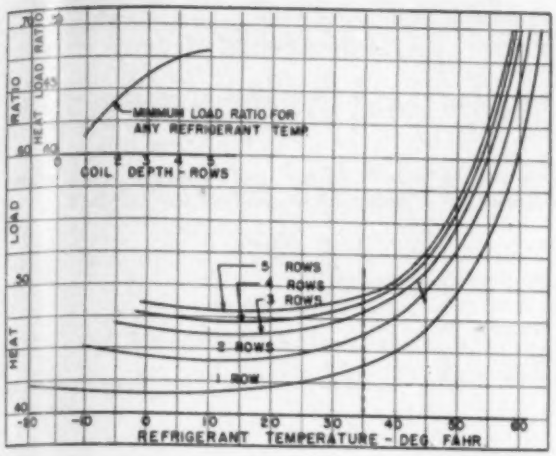


Fig. 11—Effect of coil depth on heat load ratio for constant entering air condition

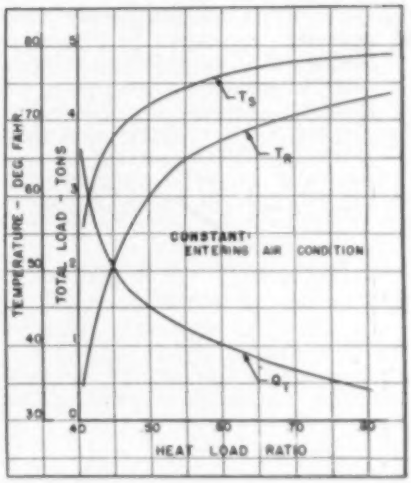


Fig. 12—Effect of heat load ratio on coil performance

coil tests. These constants depend only on fundamental coil design and need not be obtained for each different coil depth.

2. For direct expansion coils that may be required for either dehumidification or dry cooling alone, a surface area ratio between 15 and 20 is recommended because little effect on coil performance is obtained when the surface ratio is increased beyond 20. Figs. 6 through 9 show the effect of changing this area ratio from 5 to 30 by various means and for different conditions of coil operation. Near a value of 20, the refrigerant coefficient referred to air-side surface, $\frac{h_r}{R_s}$, becomes nearly equal to the air-side coefficient. Therefore little can be gained by a further increase of external surface because the refrigerant coefficient becomes the limiting factor in heat transfer.

3. There is little advantage gained in designing a coil more than 7 rows deep, if a surface area ratio of between 15 and 20 is used. This is shown in Fig. 10 where the load curve and refrigerant temperature curve level off rapidly after a depth of 7 rows is reached. This figure has been drawn for an average coil with ⅝ in. O.D. tubes, and therefore, does not necessarily apply to unusual designs which may have very closely spaced rows of smaller diameter tubes. For these special cases, the optimum coil depth should be chosen by constructing curves similar to those of Fig. 10 through the use of the equations of Table 1. For a general approximation which applies to all coils, however, the maximum coil depth may be selected on the basis of whatever depth is required to provide an air-side surface area of about 100 sq ft per square foot of face area.

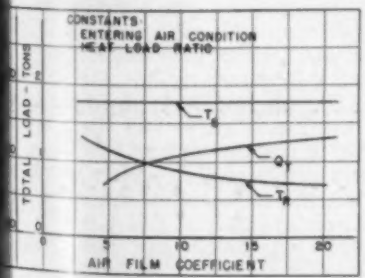
4. For a given coil depth, there is a minimum sensible to total heat load ratio that may be obtained regardless of refrigerant temperature or load. This is shown in Fig. 11 which indicates that the minimum heat load ratio for a given type of coil surface increases with coil depth.

5. Steep load ratio lines require very low refrigerant temperatures as indicated in Fig. 12. Also, as just cited above, shallow coils are usually required. This explains why reheat is often used in practical coil applications involving steep ratio lines. By using a deeper coil, a higher refrigerant temperature may be satisfactory and a smaller compressor may be used. Reheat may then be applied to the air leaving the coil to decrease the load ratio to the desired amount.

6. Increasing the value of the air film coefficient beyond about 15 Btu per hr per sq ft per deg F for a direct expansion coil having a surface area ratio between 15 and 20, has little effect on coil performance as indicated in Fig. 13. Since this coefficient increases with velocity, it might be reasoned that the air velocity is likewise limited at some value that would correspond to a coefficient of 15. However, an examination of Equation 1 and Fig. 14 will show that this is not the case. For a constant load ratio and constant entering condition, the coil load is practically a straight line function of the air velocity while the refrigerant temperature decreases in the same manner. The limiting face velocity for a coil may often be determined by the amount of carry-over of moisture that occurs at the downstream coil face. With usual coil designs, this velocity is about 600 fpm.

7. In spite of the fact that only limited data are available on refrigerant coefficients, little error will result in compressor selections based on these coefficients which have been determined from tests under typical operating conditions. This is because large changes in refrigerant coefficient have only a

Fig. 13—Effect of air film coefficient coil performance



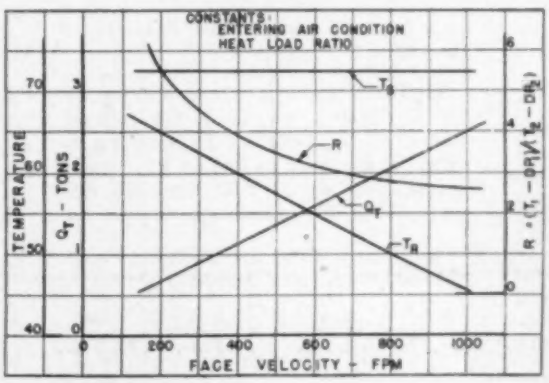
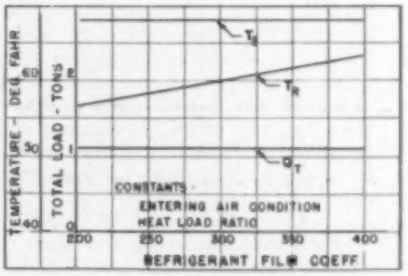


Fig. 14—Effect of face velocity on coil performance

Fig. 15—Effect of refrigerant film coefficient on coil performance



slight effect on refrigerant temperature. As shown in Fig. 15 a change of plus or minus 25 per cent in refrigerant coefficients results in a change of only plus or minus 1.5 deg in refrigerant temperature. The properties of commercially obtainable freon 12 often vary by more than this amount.

APPENDIX I
Examples of Coil Selection

Problem

An industrial application requires the cooling of a certain quantity of air from a condition of 102 F dry-bulb and 85 F wet-bulb to a final condition of 80.5 F dry-bulb and 73 F wet-bulb. The air velocity across the coil is to be 400 fpm and coil data are as follows:

$h_s = 10.7$ at 400 fpm

$h_r = 325$

External surface area = 15 sq ft per sq ft of face per row of coil depth.

Ratio of external surface area to internal surface area = 15.

Solution

1. Lay out the problem psychrometry as indicated in Fig. 16 and note that the minimum horizontal distance between the load ratio line and the saturation curve is 1.8 F dry-bulb at point A Fig. 16. This means that $T_s - DP_s$ in Equation 1 must not be less than 1.8. Therefore, Equation 1 should be solved for N to determine the proper number of rows to be used for the coil.

$$\frac{h_s \times A_s N}{0.243\, G_s} = \log_e \frac{T_1 - DP_1}{T_2 - DP_2}$$

$$= \log_e \frac{102 - 80}{1.8} = \log_e 12.22 = 2.5$$

Then substituting values for h_s, A_s, and G_s, N may be found as follows:

$$\frac{10.7 \times 15N}{0.243 \times 1740} = 2.5 \text{ or } N = 6.58$$

2. This establishes the maximum whole number of coil rows that can be used as 6 and it is now possible to determine the actual location of the exit air conditions from Equation 1 by solving for the actual value of $T_s - DP_s$ for a 6 row coil.

$$\frac{10.7 \times 15 \times 6}{0.243 \times 1740} = \log_e \frac{102 - 80}{T_2 - DP_2} = 2.275$$

This establishes values of 9.78 for $\frac{T_1 - DP_1}{T_2 - DP_2} = R$ and 2.25 for $T_2 - DP_2$.

3. Next, the exit air condition at 57.3 F dry-bulb and 56 F wet-bulb as shown at B, is found by locating a point on the load ratio line at a horizontal distance of 2.25 dry-bulb degrees from the saturation curve.

4. The surface temperature may now be found from Equation 2.

$$T_s = \frac{9.78 \times 57.3 - 102}{8.78} = 52.3$$

5. The total coil load may be calculated from the enthalpy difference across the coil and the air quantity using the weight of dry air instead of the weight of the mixture.

$$Q_t = G_{da}\,(h_1 - h_2)$$

$$= 1700\,(49.24 - 23.77)$$

$$= 43{,}200 \text{ Btu per hr per sq ft of face area}$$

6. The refrigerant temperature may be found from Equation 3

$$\frac{43200}{15 \times 6 \times \frac{325}{15}} = T_s - T_r = 22.1$$

Therefore, $T_r = 52.3 - 22.1 = 30.2$.

Thus a coil 6 rows deep operating at a refrigerant temperature of 30.2 F and a face velocity of 400 fpm is required and it will carry a total load of 43,200 Btu per hour per square foot of face area. The air conditions leaving the coil are too low for the conditions of the problem and therefore it is necessary to by-pass air at the entering condition to obtain the desired result of 80.5 F dry-bulb and 73 F wet-bulb.

Although the above solution is satisfactory, it may be more desirable in some cases to use a higher refrigerant temperature and employ reheat to obtain the desired load ratio. Such a solution is shown in Fig. 17. In this case the coil load ratio line intersects the saturation curve and therefore a coil of any depth may be selected.

If a coil depth of 6 rows is maintained, the exit air conditions for the coil are indicated at point B Fig. 17 as 72.3 F dry-bulb and 70.8 F wet-

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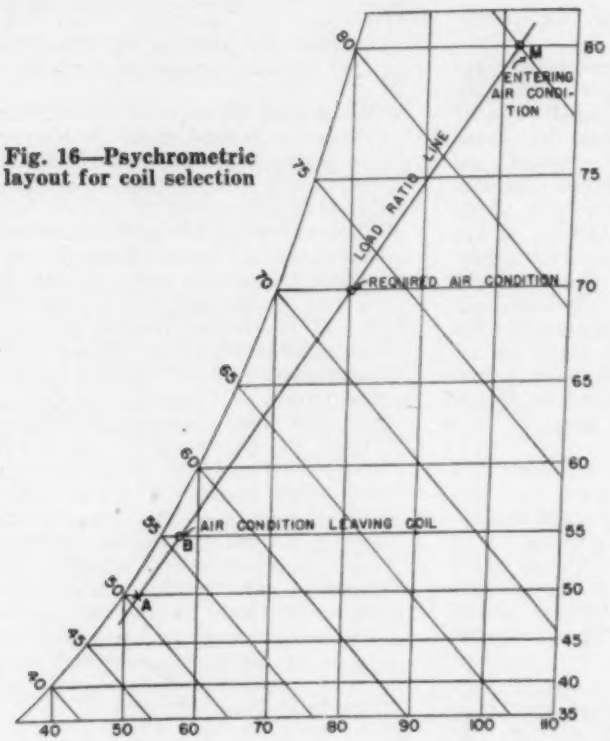

Fig. 16—Psychrometric layout for coil selection

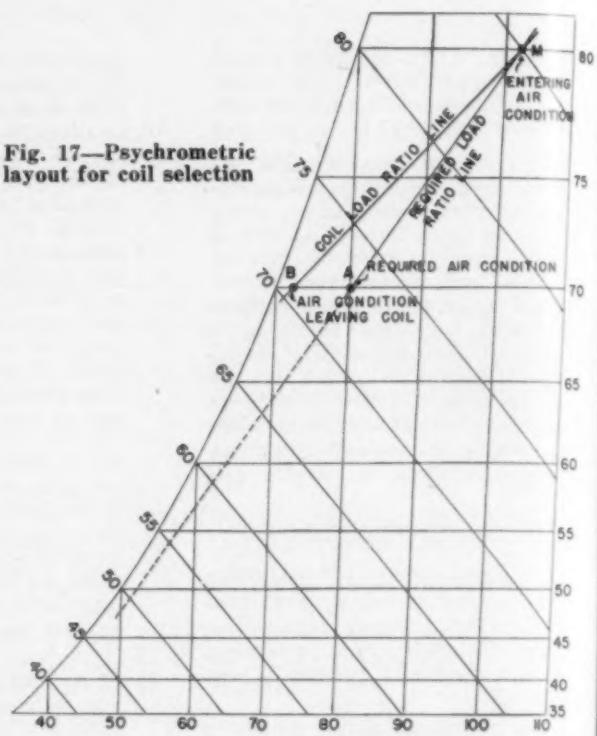

Fig. 17—Psychrometric layout for coil selection

Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam Heating Equipment

By D. S. McKinney*, J. J. McGovern**, C. W. Young†, Pittsburgh, Pa., and L. F. Collins††, Detroit, Mich.

This paper is the result of research sponsored by the American Society of Heating and Ventilating Engineers in cooperation with Carnegie Institute of Technology

SUMMARY—Venting of steam condensers as a means of governing the CO_2 content of condensates, and, thus, of controlling corrosion, is of little value when the incoming steam contains less than 5 ppm of CO_2.

With steams rich in CO_2 intelligent venting provides a means of producing condensates containing CO_2 concentrations of the same magnitude as otherwise can be obtained from "commercially pure" steams produced from carbonate-bearing feedwaters.

THIS PAPER presents the results of cooperative research studies[1] aimed at revealing, within practical limits, the possibilities of preventing the solution of CO_2 in condensates by venting of the vapor space of steam heating equipment. This work was undertaken in an attempt to discover another means of minimizing corrosion of condensate return lines, when, perforce, CO_2-bearing steams must be used. It was predicated upon the previously published findings of one of the authors which show that, other conditions being fixed, corrosion of condensate lines decreases as the dissolved CO_2 content of the condensate decreases.

General Findings

The general findings are that venting of the vapor space of steam condensers does not provide a means of producing CO_2-free condensates even when steams containing small concentrations of the gas are used. Notwithstanding, it is possible to produce thereby, from steams *rich* in CO_2, condensates containing gas concentrations of the same order of magnitude (2 to 4 ppm) as ordinarily are formed in equipment using steams of the *lowest* CO_2 content (*i.e.*, about 5 ppm) that are now generated from carbonate-bearing feedwater upon a commercial scale. Theoretically, therefore, venting provides a means of minimizing but not entirely preventing corrosion. Its general use, however, must await the commercial availability of suitable venting devices.

General Considerations

In 1939, Collins[2] published the curves reproduced in Fig. 1. These show that, other conditions being fixed, corrosion is proportional to the CO_2 concentration of condensates. The work of Mills and Urey[3] and their predecessors show that, at heater temperatures, equilibrium of CO_2 between steam and condensate can be attained in an extremely short period of time. At equilibrium, the CO_2 content of any condensate, free of alkaline entrainment, will be directly proportional to the partial pressure of CO_2 in the vapor phase contacting the condensate. In his latest publication, Collins[4] shows that in conventional designs of steam heating equipment, using CO_2-bearing steam, stratification of CO_2 and steam occurs and that the concentrations of CO_2 which eventuate may cause the hot condensate to

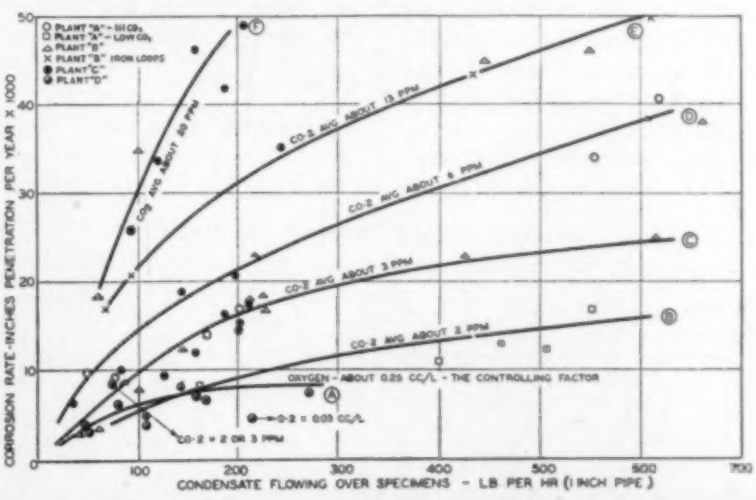
CORROSION RATE-INCHES PENETRATION PER YEAR X 1000
CONDENSATE FLOWING OVER SPECIMENS - LB PER HR (1 INCH PIPE)
CO2 AVG ABOUT 13 PPM
CO2 AVG ABOUT 5 PPM
CO2 AVG ABOUT 3 PPM
CO2 AVG ABOUT 2 PPM
OXYGEN - ABOUT 0.25 CC/L - THE CONTROLLING FACTOR

Fig. 1—Curves showing the relation between corrosion and gas content of condensate when varying quantities of condensate are flowing

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†Teaching Assistant, C.I.T.

††Chairman, ASHVE Technical Advisory Committee on Corrosion. Member of ASHVE.

[1]Cooperative Research at Carnegie Institute of Technology, September, 1942, to December, 1943, sponsored by the ASHVE Technical Advisory Committee on Corrosion.

Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January 1945.

[2]Corrosion in Steam Heating Systems, by L. F. Collins and E. L. Henderson. (*Heating, Piping and Air Conditioning*, Sept. 1939 to May 1940, incl.)

[3]*Journal American Chemical Society*, Vol. 62, p. 1019, 1940.

[4]Studies of the Mechanism of Solution of CO_2 in Condensates Formed in the Steam Heating Systems of Buildings, by Leo F. Collins. (Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January 1945.)

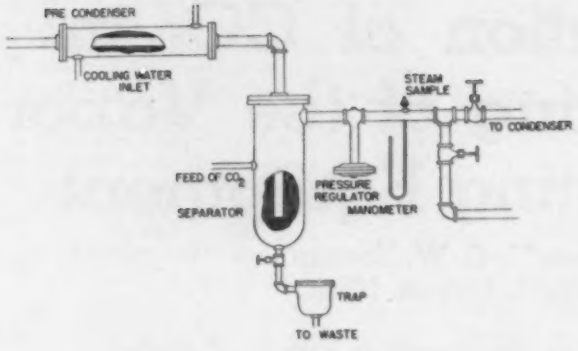


Fig. 2—Arrangement of equipment preceding experimental condensers

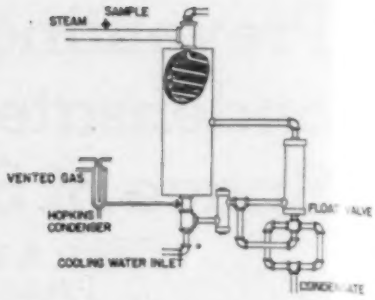


Fig. 3—Arrangement of experimental condenser No. 1

dissolve an amount of CO_2 equal to that in the incoming steam.

From these observations it can be reasoned that, if CO_2 can be prevented from accumulating in the vapor space, lower partial pressures of CO_2 will result, less will dissolve in the condensate, and, therefore, the latter will have a proportionately lower potential corrosivity. It was the aim of the present studies to determine the practical possibilities of venting gaseous CO_2 from the vapor space of heating equipment operating at high condensing rates, such as a water heater.

Experimental Approach

In the design of all heating equipment, the principal objective sought is to achieve the ultimate in thermal economy. Normally, steam and condensate are caused to flow in the same direction. In addition, in some units, wherein water is the cooling medium, steam and condensate are caused to flow counter current to the cooling water as a result of which *undercooling* of the condensate occurs.

In view of the principles set forth in the preceding paragraph, it will be recognized that the design features cited favor solution of CO_2 in the condensate. If this is true, then it should follow that, if steam and condensate are made to flow in opposite directions and if the CO_2, which accumulates at the end of the steam path, is vented to the atmosphere, conditions favoring solution of a minimum of CO_2 in the condensate should be produced. The present studies were conducted in such a manner as to test these postulates.

Test Technique

Steam from a main supplying the laboratory building was used throughout the tests. To minimize the interference of entrained boiler water salines, and to facilitate enrichment of the steam with CO_2 when desired, the equipment preceding the condensers was arranged as shown in Fig. 2.

In all tests, to prohibit the escape of undissolved gas along with the condensate, the condensate line was kept flooded at a predetermined level. This was accomplished automatically by means of a *home-made* constant-level float valve. Essentially, this device consisted of a glass float linked to a carefully machined brass cylinder. As the latter raised or lowered, it throttled the exit port in the condensate line.

Condenser No. 1

This unit was a water heater of the helical coil-type, made entirely of copper alloy. The exterior surface of the coil and the interior surface of the jacket were heavily tinned to eliminate the possible effects of corrosion products. It had a rated capacity of 180 gal per hour when utilizing steam at atmospheric pressure, with an inlet water temperature of 40 F and an outlet water temperature of 140 F, *i.e.*, it contained about 3.5 sq ft of heating surface.

The first series of tests were made with steam and condensate flowing in the same direction and counter-current to the cooling water —*i.e.*, conventional operation. A steam pressure of 3 psi gage was maintained, and the cooling water was regulated so as to cause condensation of about 225 lb of steam per hour.

The vent and subsequent venting apparatus were arranged as shown in Fig. 3. With these arrangements, data were collected while venting steam at different rates up to 1.81 per cent of that entering the heater, with the incoming steam containing about 4 ppm of CO_2, and also after it had been enriched to contain about 40 ppm of the gas.

The data collected are summarized in Table 1. The values shown are an average of 4 readings taken at consecutive 15-min intervals after the unit had operated sufficiently long, at a given venting rate, to reach a steady state.

When an attempt was made to operate this unit with counter-flow of steam and condensate, it was found impossible to condense as much steam as in the first series of tests. Because of this experimental difficulty it was decided to cease work with this unit and to begin the studies on Condenser No. 2.

Table 1—Average Results Obtained with Heater No. 1

Condensing Rate Lb per Hr	CO_2 ppm in Incoming Steam	CO_2 ppm in Vent Steam	CO_2 ppm in Condensate	Venting Rate[a]	Per Cent of Incoming CO_2 Measured in Condensate	Per Cent of Incoming CO_2 Measured in Vented Steam
238	3.6	134	1.7	1.73	42.6	57.4
222	3.0	163	1.4	1.25	45.7	54.3
241	3.8	252	2.3	0.90	49.0	51.0
226	3.3	407	1.8	0.43	47.2	52.9
232	39	1886	6.2	1.81	15.7	84.3
232	44	3500	8.2	0.98	19.3	80.7
225	37	3300	6.1	0.94	16.6	83.4
238	33	5290	8.0	0.52	23.9	76.1
236	44	6940	11.1	0.43	27.1	72.9

[a]As Per Cent of Incoming Steam.

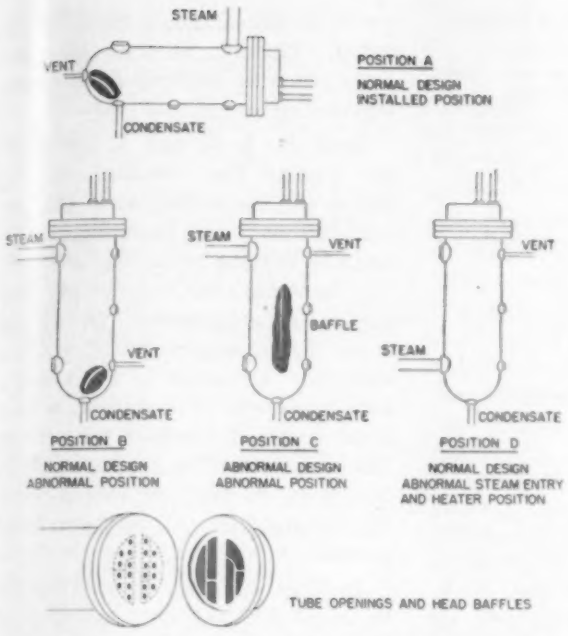


Fig. 4—Arrangements of experimental condenser No. 2

Condenser No. 2

This unit was a water heater of the hair pin tube type. The tubes were of copper alloy, and the shell was of steel. Prior to starting the test, all the inside surfaces of the shell and the outside surfaces of the tubes were tin plated. This was done to avoid interference of corrosion products, which conceivably may affect the solubility of CO_2 in condensates so contaminated. It has been shown[5] that tin is practically immune to carbonic acid corrosion. This heater had a rated capacity of 400 gal per hour when utilizing steam at atmospheric pressure, with an inlet and outlet water temperature of 40 and 180 F respectively, *i.e.*, it contained 9 sq ft of heating surface.

In all the tests involving Unit No. 2, a vent-condenser[6] was used which differed in one respect from the design used with Unit No. 1. Why this change was made is described later in the paragraph entitled "Criteria for the Design of Venting Devices."

With the heater positioned and/or arranged in the four different ways, depicted by the sketches in Fig. 4, tests were made at condensation rates corresponding to 300 and 600 lb of steam, approximately, per hour at 3 psi gage. For each condensation rate, tests were made at CO_2 levels in the incoming steam of 30 and 60 ppm respectively. For each CO_2 level, tests were run at rates of venting corresponding to 0.25, 0.50, and 1.0 per cent of the weight of steam entering the heater in unit time.

In every test, the following general procedure was used :

The heater was put into operation and adjustments were made to give the desired condensation rate. The CO_2 feed to the incoming steam was set at a predetermined value, as was also the venting rate. When the system had reached a steady state (usually in about one-half hour) as shown by preliminary checks, readings were taken. The data hereinafter presented represent the average of the values obtained from three or more consecutive readings made at about 20-min intervals. Thereafter, the venting rate was changed to a lower predetermined value and the above procedure repeated.

Normal Design and Installed Position—(A): With the unit installed in a horizontal position (arrangement A, Fig. 4), *which is its normal position in actual practice,* it seems permissible to assume that, as the condensate from the upper elevation gravitates downward, it is likely to contact cooler tubes. This, coupled with the fact that at the lowest level the gas phase richest in CO_2 persists, should make for maximum solution of the gas in the condensate. The heater in question was provided with a vent, as shown by arrangement A of Fig. 4 and tested under these conditions. The average results obtained are given in Table 2.

Table 2—Average Results—Heater No. 2—Normal Design and Installed Position

Condensing Rate Lb per Hr	CO_2 ppm in Incoming Steam	CO_2 ppm in Vent Steam	CO_2 ppm in Condensate	Venting Rate[a]	Per Cent of Incoming CO_2 Measured in Condensate	Per Cent of Incoming CO_2 Measured in Vented Steam
630	61	4035	13	1.08	21.4	76.9
630	56	7550	17	0.50	30.4	69.0
606	55	11158	23	0.27	42.0	56.0
614	34	2108	11	1.11	32.4	69.1
614	33	3357	14	0.54	43.0	56.7
612	33	5894	15	0.25	45.4	54.6
366	59	4728	15	0.95	25.4	74.9
366	58	12148	17	0.35	28.6	72.3
366	58	18420	17	0.24	29.6	70.8
370	29	2470	11	0.75	37.6	62.1
366	31	4605	10	0.45	31.0	67.8
366	29	9142	9	0.22	31.0	66.9

[a]As Per Cent of Steam Entering Unit.

Table 3—Average Results—Unit No. 2—Normal Design—Abnormal Position

Condensing Rate Lb per Hr	CO_2 ppm in Incoming Steam	CO_2 ppm in Vent Steam	CO_2 ppm in Condensate	Venting Rate[a]	Per Cent of Incoming CO_2 Measured in Condensate	Per Cent of Incoming CO_2 Measured in Vented Steam
575	56	2090	7	1.00	13.1	87.6
552	56	7324	9	0.70	15.8	84.5
552	60	10416	15	0.42	25.0	75.6
552	54	16078	22	0.17	40.6	55.9
578	30	2548	5	1.04	16.0	84.4
576	32	4664	9	0.61	24.2	75.5
576	39	7008	10	0.38	25.6	73.4
576	32	10748	13	0.19	41.2	59.0
315	55	4620	7	1.11	12.4	86.1
321	56	10757	12	0.42	20.6	80.3
315	54	13685	17	0.27	31.8	68.3
330	33	3130	7	0.93	20.9	79.9
330	31	4826	11	0.46	34.5	65.6
330	32	7485	14	0.24	43.6	56.6

[a]As Per Cent of Steam Entering Unit.

[5]More Information on Corrosion in Steam Heating Systems, by L. F. Collins. (Proceedings 4th American Water Conference *Engineers' Society of Western Pennsylvania*, November 1943.)

[6]In all tests, a modified Hopkins Condenser was used as a vent condenser. This is a small glass condenser common to chemical laboratories.

Table 4—Average Results—Unit No. 2—Abnormal Design—Abnormal Position

Condensing Rate Lb per Hr	CO_2 ppm in Incoming Steam	CO_2 ppm in Vent Steam	CO_2 ppm in Condensate	Venting Rate[a]	Per Cent of Incoming CO_2 Measured in Condensate	Per Cent of Incoming CO_2 Measured in Vented Steam
550	59	6150	2	1.15	3.5	97.1
555	59	10630	3	0.55	5.1	95.0
560	57	21172	4	0.29	6.9	93.0
606	36	2900	4	1.07	11.1	89.0
579	35	5995	5	0.54	14.2	86.0
598	35	11546	6	0.26	17.2	82.4
300	60	5741	4	1.05	6.7	93.1
300	59	11233	5	0.53	8.5	92.7
300	60	21710	6	0.24	10.0	89.3
316	30	2778	4	1.00	13.3	87.1
310	30	5422	4	0.51	13.3	87.2
310	31	9648	6	0.25	19.3	81.0

[a]As Per Cent of Steam Entering Unit.

Normal Design—Abnormal Position—(B): In this series the heater's original design was not modified, but the unit was positioned so the tubes were vertical, *i. e.*, arrangement B of Fig. 4. With such an arrangement, it seems improbable that undercooling of the condensate can take place. Under these conditions, the average results obtained are those given in Table 3.

Abnormal Design—Abnormal Position—(C): For this series, the heater's design was modified to the extent that a baffle was installed to direct the path of the steam, as shown in arrangement C of Fig. 4, and the vent was relocated, as is also shown in the sketch. By this arrangement, undercooling of the condensate was prevented, and the CO_2 which normally accumulates at the bottom was forced to the top of the unit. Under these conditions, the average results obtained are those given in Table 4.

Normal Design—Abnormal Steam Entry and Heater Position—(D): In this series, the steam was caused to enter the unit close to the normal condensate level, and the vent was located at the top of the unit, as shown in arrangement D of Fig. 4. This, in effect, was the same as the arrangement in the tests of series C but accomplished without installing the baffle. With this arrangement, the average results obtained are those given in Table 5.

Venting Efficiencies

A comparative study of the data from the five series of tests indicates clearly that control of the CO_2 content of condensates, formed from and in contact with CO_2-bearing steams, by venting of the vapor space is limited and conditioned by:

1. The amount of steam vented in unit time.
2. The CO_2 content of the incoming steam.
3. The proper location of the bleed point.
4. Design characteristics of the unit in question.

Optimum Percentage of Venting

There are well informed engineers who contend that the venting of steam heating equipment, as a means of thwarting corrosion, is predestined to be impractical. Their capital argument is that the problem of disposing of the vented steam will be as costly and involved as the replacement of those parts which normally fail due to corrosion.

It will be shown later that, conceivably, there are rather simple ways for disposing of small amounts of vented steam. It will also be shown that, when intelligently employed, venting of small amounts of steam effectively minimizes the CO_2 content of condensates. Accordingly, it is believed that the present studies outline a method for control of carbonic acid corrosion that heretofore has not been available for use by steam utilization engineers.

Prior to the inauguration of these studies, it was decided, quite arbitrarily, that for venting to be practical, not more than about two per cent of the steam entering a given condenser could be so dissipated. Thus it is that all tests were made at venting rates below two per cent.

In Figs. 5, 6, and 7, inclusive, are plotted the amounts of CO_2 found in the condensates (as per cent of that in the incoming steam) against venting rates, for different CO_2 contents (of the steam) and heater arrangements. In all of these charts it is clear that venting efficiency[7] decreases as the venting rate increases. Apparently, a rate equal to about one-half per cent of the steam entering a given unit is the most efficient, providing venting is done from the optimum bleed point.

In Figs. 5, 6, and 7, plotting the value of 100 per cent solution of the gas at zero venting rate is not based upon an academic postulate. Tests of both heaters showed that this occurs. When unit No. 1 had reached a steady state, the vent was suddenly closed. Under these conditions, complete solution of the gas was brought about in about 30 min. When unit No. 2, arranged as shown by arrangement A of Fig. 4, had reached a steady state, at a venting rate of 1.35 per cent, closing of the vent brought about complete solution of the gas in about 20 min at a condensing rate of 600 lb of steam per hour.

Effect of CO_2 Concentrations in Incoming Steam

Venting efficiency decreases as the CO_2 content of the incoming steam decreases. For CO_2 content of steam below about 4 ppm, vent-

[7]Since the per cent of CO_2 removed is not a straight line function of the per cent of steam vented, doubling the venting rate does not halve the per cent CO_2 remaining in the condensate.

Table 5—Average Results—Unit No. 2—Abnormal Steam Entry and Heater Position

Condensing Rate Lb per Hr	CO_2 ppm in Incoming Steam	CO_2 ppm in Vent Steam	CO_2 ppm in Condensate	Venting Rate[a]	Per Cent of Incoming CO_2 Measured in Condensate	Per Cent of Incoming CO_2 Measured in Vented Steam
624	58	4863	4	1.01	6.9	92.5
614	57	9193	4	0.55	7.0	93.1
608	55	17328	6	0.27	10.9	89.1
612	31	2517	3	1.05	9.7	90.2
614	30	4700	3	0.53	10.0	89.8
612	27	8923	4	0.26	14.8	85.4
310	60	6136	3	1.02	5.0	95.3
310	61	11778	4	0.51	6.6	94.0
310	60	21788	5	0.27	8.3	92.0
328	28	2714	2	0.96	7.1	92.4
324	28	5227	3	0.48	10.7	89.3
324	30	10789	6	0.25	20.0	79.6

[a]As Per Cent of Steam Entering Unit.

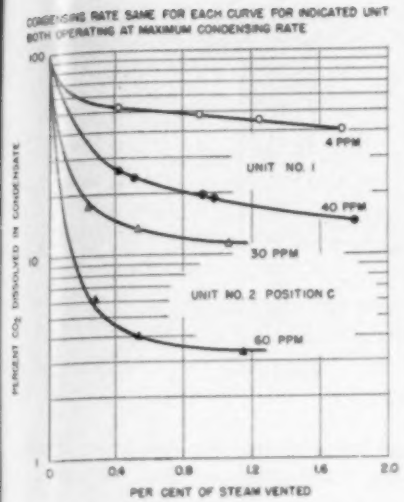

CONDENSING RATE SAME FOR EACH CURVE FOR INDICATED UNIT BOTH OPERATING AT MAXIMUM CONDENSING RATE
PERCENT CO_2 DISSOLVED IN CONDENSATE
4 PPM
UNIT NO. 1
40 PPM
30 PPM
UNIT NO. 2 POSITION C
60 PPM
PER CENT OF STEAM VENTED

Fig. 5—Effect of CO_2 content in incoming steam upon CO_2 in condensate at different venting rates

ing is apparently of little practical value. The latter observation is attested by the curves in Fig. 5. It should be noted that the data for unit No. 2, plotted therein, which pertain to series C are practically identical with the results obtained with series D.

Optimum Bleed Point

Obviously, the optimum bleed point is at that location where the highest CO_2 concentration exists. While ordinarily this will be close to the condensate level, *i.e.*, in the bottom of the unit, it may be elsewhere, depending upon the direction and path of steam flow. The point of highest CO_2 concentration is always at the end of the steam path. It was for these reasons that in the tests of series A and B venting was from the bottom, whereas in series C and D it was from the top of the experimental unit.

Initially, there is a temptation to postulate that CO_2 accumulates at the bottom of conventional types of steam-condensing apparatus because of the differences in density between steam and CO_2. That such accumulations are due to steam flow rather than to differences in gas densities is attested by the findings of series A and B as contrasted with those of series C and D. The data in Tables 4 and 5 show higher CO_2 values for the vented steam than in Tables 2 and 3, all other conditions being equal. It is inconceivable that this could have occurred if gas densities were the controlling factor.

With the unit arranged as shown by B of Fig. 4, which is essentially an orthodox arrangement, the vent was suddenly closed so that the gas could accumulate. When equilibrium became established, *i.e.*, the amount of CO_2 dissolved in the outgoing condensate equalled that entering with the steam, sufficient heating surface had been blanketed with gas to reduce the steam condensing rate slightly over one per cent. With the arrangement shown by D of Fig. 4, which is an unorthodox arrangement, when equilibrium had become established, the steam condensing capacity had been decreased about 30 per cent. Certainly, therefore, an arrangement such as is shown in D is definitely impractical unless a suitable venting apparatus is provided.

Effects of Design Characteristics

The curves in Fig. 6 contrast the CO_2 dissolved in the condensate for the two units studied, when both were operated in an orthodox manner at maximum condensation rates and with steams of comparable CO_2 contents. The better performance of unit No. 1, it will be shown presently, resulted from the fact that undercooling of the condensate did not take place as is the case for the values relating to unit No. 2.

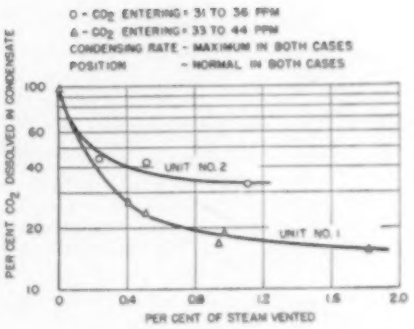

○ - CO_2 ENTERING = 31 TO 36 PPM
△ - CO_2 ENTERING = 33 TO 44 PPM
CONDENSING RATE - MAXIMUM IN BOTH CASES
POSITION - NORMAL IN BOTH CASES
PER CENT CO_2 DISSOLVED IN CONDENSATE
UNIT NO. 2
UNIT NO. 1
PER CENT OF STEAM VENTED

Fig. 6—Comparison of CO_2 content in condensate for units 1 and 2 operated at maximum condensation rate with steam of comparable CO_2 content

The curves in Fig. 7 show the average results obtained with unit No. 2 when it was arranged in the four different ways, depicted by the sketches in Fig. 4 but operated at two different condensation rates and two CO_2 levels for the incoming steam.

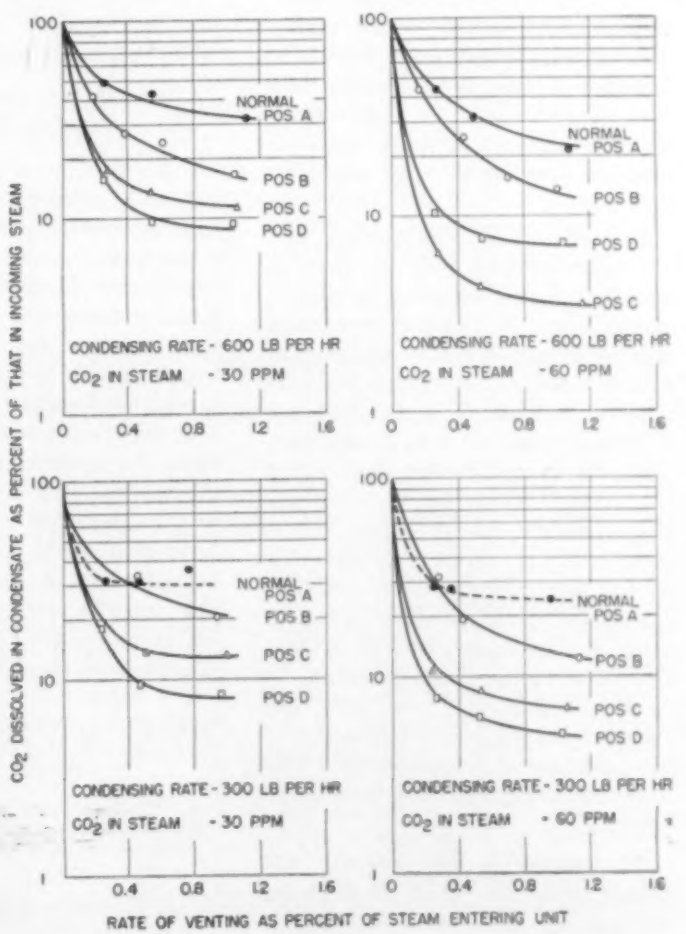

CO_2 DISSOLVED IN CONDENSATE AS PERCENT OF THAT IN INCOMING STEAM
NORMAL
POS A
POS B
POS C
POS D
CONDENSING RATE - 600 LB PER HR
CO_2 IN STEAM - 30 PPM
CO_2 IN STEAM - 60 PPM
CONDENSING RATE - 300 LB PER HR
RATE OF VENTING AS PERCENT OF STEAM ENTERING UNIT

Fig. 7 — Effect of four different arrangements on unit No. 2 when operated at two condensation rates and two CO_2 levels

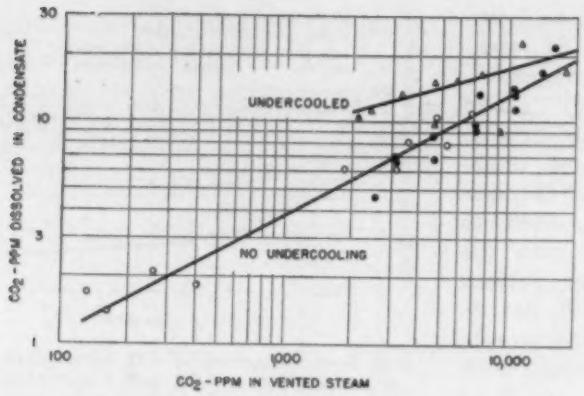


Fig. 8 (left)—Effect of undercooling upon CO_2 dissolved in condensate

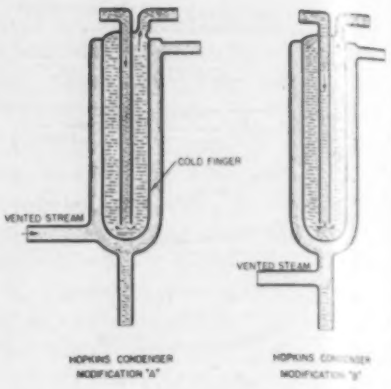


Fig. 9 (right) — Construction of modified Hopkins condenser used in early experiments with Unit No. 1

These charts demonstrate clearly (1) the effects of undercooling of the condensate, and (2) the value of utilizing steam scavenging.

In a unit of this design, arranged in its normal position, the condensate formed at the upper elevations is likely to contact progressively cooler tubes. This favors *undercooling* of the condensate and should become more pronounced as the rate of condensation increases. It has been shown, too, that with such an arrangement, the vapor in contact with the undercooled condensate is richest in CO_2; that both of these factors make for maximum solution of CO_2 under otherwise identical conditions. That this occurred is clearly shown by the data plotted in Fig. 7. That undercooling takes place more at high condensation rates is similarly shown.

The effects of undercooling can be demonstrated, too, in another manner. By comparing arrangements A and B it can be visualized that in arrangement B the condensate drained quickly from the vertical tubes, while in arrangement A it flowed from one tube to another. Thus, it should follow that other conditions being equal, a given CO_2 content in the gas phase should bring about less solution of CO_2 in the condensate with arrangement B than with arrangement A. The curves in Fig. 8 show the relationship found to exist. It is interesting to note that the values for unit No. 1 subscribe to the lower curve. Apparently in this unit undercooling did not take place.

In comparing the results obtained by the two methods of steam scavenging, it is seen that except in one series, bringing the *purest* steam into contact with the outgoing condensate is the most effective. The exception, however, focuses attention upon an important point, namely, the necessity for causing the steam to follow a predetermined path, which encompasses the whole area of the condensate. Because of the high condensation rate used in the tests of series D and the high CO_2 in the incoming steam, it is believed a *secondary pocket* of CO_2 accumulated, thus curtailing the effectiveness of the scavenging steam. This same phenomenon has been experienced in early design of deaerating types of industrial boiler feedwater heaters.

Criteria for the Design of Venting Devices

Practically, venting is impossible with equipment operating at subatmospheric pressures. On the other hand, a system in which the condensing equipment operates at positive pressures and the return lines under negative pressures would appear to yield most readily to the employment of venting.

In building steam heating equipment, it rarely happens that a single piece of equipment is found which condenses more than about 1000 lb of steam per hour. If venting of about one-half per cent of the incoming steam represents the optimum venting rate, then disposal of not more than five pounds of condensate per hour comprises the mechanics of the problem of venting.

To be practical, the venting device should separate the noncondensable gases from the condensate formed in the venting device and purge them to the atmosphere, returning the condensate, containing a negligible amount of dissolved gas, to the main return line.

Throughout the early experiments with unit No. 1, the modified Hopkins condenser was constructed as shown by arrangement A in Fig. 9. With this design, the vented condensate immediately contacted the *cold finger* and tended to *hold* CO_2. For this reason, the condenser was further modified as shown in arrangement B of Fig. 9. In this design the condensate in the venting apparatus is continuously *boiled* by the incoming steam. The gas content of the condensate leaving both types of apparatus, under otherwise identical conditions, is typified by the data in Table 6. Clearly, the modified design B was a distinct improvement.

It is believed that condensate of the quality typified by the data for design B may safely be returned to the main return line. While its CO_2 content will be comparatively high, the amount of condensate produced is so small that the increase in CO_2 concentration of the aggregate in the main return line will not be of practical importance.

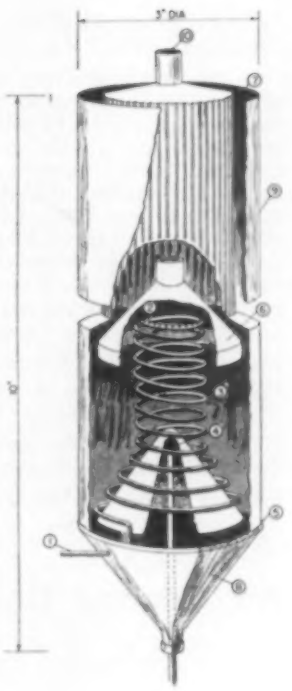
Table 6—Data Comparing the Performance of Two Modified Hopkins Condensers

Modification A			Modification B		
Steam Condensed Lb per Hr	CO_2 ppm in Steam to Condenser	Condensate Leaving Condenser	Steam Condensed Lb per Hr	CO_2 ppm in Steam to Condenser	Condensate Leaving Condenser
4.2	1886	12	..	....	....
2.8	3500	35	3.1	2714	28
1.2	5290	375	1.6	5227	100
1.0	6940	967	0.8	10789	156

In the design of a venting device which utilizes water as the cooling medium, provision should be made to guarantee no undercooling of the condensate. A device made of finned-type tubing, thus using air as the cooling medium, would appear preferable for most services. In Fig. 10 a possible design is suggested.

Insofar as the authors can determine, few if any of the so-called air vent valves, operated thermostatically, appear suitable for venting CO_2. The apparent reason is that the accumulation of CO_2 necessary to induce solution of important quantities of CO_2 does not depress the temperature of the steam-gas mixture sufficiently to cause the valves to open.

Fig. 10—One possible design of an air-cooled vent condenser



① Steam inlet
② Steam outlet orifices
③ Tubing ⅛ in. diameter
④ Condensate outlet-orificed-to main return or waste
⑤ Threaded connection
⑥ Splash plate
⑦ Fluted tubing
⑧ Sludge pocket
⑨ Shield
⑩ Outlet for gases

Materials of Construction: 18-8 stainless steel, aluminum, or tin plated copper alloys. (Same material should be used throughout.)

Note: Unit must be mounted in vertical position. Not usable on condensers operated at negative pressures.

Summary

It has been shown that by intelligent venting of the vapor space of steam condensing equipment, steams rich in CO_2 can be caused to produce condensates containing small amounts of CO_2, *i.e.*, of the order of 2 to 4 ppm; that venting is of little practical value when the incoming steam contains less than about 5 ppm of CO_2. It has been shown elsewhere[8] that where boilers must use important quantities of carbonate-bearing feedwater, the inadequacy of water processing methods now in use precludes the commercial production of steam containing less than such quantities of CO_2; that CO_2 concentrations in the condensate of the order of 2 to 4 ppm are capable of causing corrosion trouble if other contributing factors are optimum.

In view of these facts, it is clear that venting provides a means of mitigating but not entirely preventing corrosion troubles due to carbonic acid. As such, it is an expedient which lies definitely within the province of the steam utilization engineer and its effectiveness is comparable to the water processing methods available to engineers in charge of steam production.

Managements should appreciate that with the means now available, the efforts of both the steam utilization engineer and the steam production engineer are limited to minimizing rather than to preventing corrosion when perforce the steam generator uses important quantities of carbonate-bearing feedwaters.

Apparently the ultimate solution of the CO_2 corrosion problem must await the development of suitable chemicals which can be added to the steam to neutralize carbonic acid, or the development of methods for processing carbonate-bearing feedwaters so as to completely eliminate the entrainment of CO_2 with the steam. Studies dealing with neutralizing chemicals, especially those of an organic nature, are in progress elsewhere.[9] Studies dealing with the development of improved water processing methods are under consideration by the ASHVE Technical Advisory Committee on Corrosion.

Acknowledgments

To the engineers and chemists, and there were many who had no intimate concern with these studies but who, nevertheless, volunteered many helpful suggestions and much sound advice, the authors are indebted. Acknowledgment is due to Dr. J. C. Warner, Head of the Department of Chemistry, Carnegie Institute of Technology, for his patience and counsel particularly in the early days, and to Dr. J. P. Fugassi for valuable assistance and suggestions. The generosity of G. D. Winans, Engineer of Steam Distribution, The Detroit Edison Co., in loaning the experimental units, and of C. H. Fellows, Head of the Chemistry Division, Research Department of the same company, in loaning an evolution carbonate determination apparatus, is also acknowledged.

Appendix

Concerning Determination of Carbon Dioxide

In these studies, the determination of CO_2 involved the analysis of samples over an extremely wide range of concentrations. Because the accuracy of the methods commonly used to determine CO_2 has been for some time the source of considerable conjecture amongst analytical chemists, it seems entirely proper to record the experiences gained during these studies wherein several methods were used. Such is the purpose of this appendix.

Undissolved Gas

In the first series of tests (Heater No. 1), the steam supply contained 3 to 4 ppm of CO_2 and considerable air.[10] As a result, the CO_2 in the noncondensable gases vented from the unit consisted of only approximately 20 per cent CO_2. When the noncondensable gases were collected in a eudiometer tube over sulphuric acid (0.5 per cent solution) and subsequently analyzed in a Hempel apparatus, satisfactory balances were obtained. When, however, the steam was enriched so as to contain 40 ppm of CO_2—thus causing the noncondensable gases to contain about 75 per cent CO_2—this method did not give good balances. It is believed the inaccuracies resulted from solution of CO_2 in the acid.

[8]Loc. Cit. Note 2.

[9]RI Report by A. A. Berk (U. S. Bureau of Mines, 3754, June 1944).

[10]Because the boiler feedwater, from which the steam was derived, is not deaerated.

Probable Accuracy of the Analytical Data

In the tests involving steams containing CO_2 of the order of 4 ppm, no data were accepted in which the CO_2 leaving the unit via the vent plus that dissolved in the condensate differed from that entering the unit by more than 20 per cent. For CO_2 values in the incoming steam of a higher order, data differing by more than 10 per cent were rejected. Better precision could not be hoped for because of the inherent limitations of the methods available for the determinations of small concentrations of dissolved CO_2. Since the CO_2 entering the experimental condensers was determined by a method entirely different from that used in measuring the outgoing CO_2, the possibility of accidental balances due to consistent errors is precluded.

By passing the vented gases (leaving the modified Hopkins condensers) through a magnesium perchlorate filled drying tube and absorbing the CO_2 in Ascarite, satisfactory balances were obtained for CO_2 concentrations within the range 2000 to over 20,000 ppm.

Dissolved CO_2

The *ASTM* evolution method was found satisfactory but time consuming on condensates, containing up to about 1200 ppm of CO_2. On condensates not otherwise contaminated, equally good results were obtained when an excess of standard $Ba(OH)_2$ was added to a 200 cc sample and the excess subsequently back-titrated with standard hydrochloric acid using phenolphthalein as indicator.

When alkaline materials were present, such as results from the entrainment of boiler water salines, it was found that titration of samples between pH 8.5 to 5.0, using a double indicator solution of o-cresolphthalein and methyl red gave satisfactory CO_2 balances.[11] In retrospect, however, it is believed preferable to determine the bulk of the CO_2 content of steam by separation of the gas, using the Hopkins condenser, modification B and subsequent absorption of it in Ascarite. The relatively small amount of CO_2 in the condensate from the condenser can be determined by titration.

[11]Determination of Carbon Dioxide in Water, by D. S. McKinney and A. M. Amorosi. (Industrial & Engineering Chemistry, Vol. 16, p. 315, May 1944).

Air Cooling Coil Problems and Their Solutions

[*Concluded from Page* 96]

bulb and the surface temperature will be:

$$T_s = \frac{9.78 \times 72.3 - 102}{878} = 69.0$$

The coil load will be:

$Q_t = 1700\ (49.24 - 34.66) = 24{,}800$ Btu per hour per square foot of face area and the refrigerant temperature will be found from Equation 3:

$$\frac{24800}{15 \times 6 \times \frac{325}{15}} = T_s - T_r = 12.7$$

Therefore, $T_r = 69.0 - 12.7 = 56.3$.

Thus, for the case where reheat is used, a coil 6 rows deep operating at a refrigerant temperature of 56.3 F is required. The total coil load will be 24,800 Btu per hour per square foot of face area, but the actual effective load will be less by the amount of reheat required. Therefore, for a given load, a larger coil and more refrigerating capacity are required when reheat is used.

Noise Ratings of Ventilating Fans

[*Concluded from Page* 89]

Laboratory, New York Navy Yard, for considerable assistance in conducting tests to determine the acoustical properties of the room and the performance of fans tested in the room.

The opinions or assertions contained herein are the private ones of the writers, and are not to be construed as official or reflecting the views of the Navy Department, or the Naval Service at large.

NEW OFFICERS ELECTED BY ASA

The annual meeting of the American Standards Association was called to order by H. B. Bryans, president, at 2:30 p.m., December 8, 1944, New York, N. Y., with almost 300 representatives of member bodies, associate and company members, the board of directors and the standards council of the ASA, and guests in attendance.

Secretary P. G. Agnew announced that the officers of the association and of the standards council had been elected for the year 1945 as follows: *President*, H. B. Bryans; *Vice-President*, G. S. Case; *Chairman of Standards*, H. S. Osborne; *Vice-Chairman*, E. C. Crittenden.

The president reported briefly on the work of the association during the current year, and Dr. Osborne, chairman, reported on the work of the council. In closing, Dr. Osborne read a resolution which had been adopted in the board meeting the previous day in recognition of the secretary's 25 years of service in the association.

Greeting from France

F. Russell Bichowsky, former professor of chemical engineering at Catholic University, Washington, D. C., is now overseas with the Air Support Command.

Society Has Big Meeting in Boston

Hotel Statler
January 22-24, 1945

S. H. Downs
Kalamazoo, Mich.

THE 51ST ANNUAL MEETING of the Society was outstanding in the number of technical committee meetings that were held and the attention given to the 14 papers presented at the four technical sessions. With a registration of 611, of which 403 were members, it was evident that interest in the Society's work was widespread.

Sunday, January 21st was largely devoted to Committee meetings, final meetings of the Council and Committee on Research. The entire time on Monday morning was devoted to meetings of technical committees and the Chapter Delegates meeting. The first session was called to order by Pres. S. H. Downs in the Georgian Room, Hotel Statler, at 2:00 p. m., and a word of welcome was given by Earl G. Carrier, General Chairman of Committee on Arrangements, in behalf of the Massachusetts Chapter.

President Downs gave his report as follows:

President's Report

The closing of the fiftieth year of our activity as an engineering Society brings us face to face with the greatest opportunity in our history to promote the arts and sciences of heating, ventilating and air conditioning and also the general welfare. The responsibilities and potentialities coincidental with this opportunity have been recognized by your officers, committees, chapters and the general membership during the past year with the resulting widespread interest in what is being done and what is planned.

This interest has been clearly expressed by the increase of membership by about 25 per cent to a new high of approximately 4000, and the simultaneous increase of chapters to a total of 37. The new chapters are located in Denver; Columbus, Ohio; Memphis; Salt Lake City and Syracuse.

The Research Laboratory has successfully been put into operation in its new location at Cleveland and a forward looking, sound and detailed program set up which any reader of the recently published booklet will recognize as a purposeful and able approach to the needs in our field.

The Guide continues its great importance in the affairs of the Society and is the recognized authority in its field. It produces revenue without which the Society could not operate on its present scale.

Our finances are on a sound basis and properly liquid in accordance with constitutional requirements.

The Society and its members have continued to support the prosecution of the war by every possible means; and a great deal of our present planning will contribute largely to conversion to peacetime pursuits. A significant action in this respect is our invitation to a number of technical societies and organizations to appoint representatives to an International Joint Committee on Psychrometric Data, which has received prompt, complimentary support. A proposal for an additional joint committee on the subject of Industrial Ventilation and Air Conditioning is in the making.

The continuous publication of technical papers in the Journal and the reports of chapter activities therein evidence a most satisfactory carrying forward of the objects of the Society and the usefulness of the speakers' bureau to the chapters.

The detailed reports of other officers and the several committees present a picture of careful stewardship in their assigned duties and a planned mustering of the assets and capabilities of the Society that is essential to realizing our hopes for the future.

In the last three years, I have been able to visit practically every chapter, including our newest ones, and I am continually impressed with the unselfish, cooperative efforts put forth by the chapter organizations and the individual members. In view of the benefit obtained by visiting chapters during the two years as vice-president, I adopted the policy this year of having the first and second vice-presidents visit a number of the chapters. This policy is beneficial to the Society as a whole, the chapters and the individual officers, in that it creates a longer period of direct contact between the chapters and the officers, as well as freeing the president for appearances before other organizations, which function will be of increasing importance in the future.

Our Society is still the only engineering Society with its own laboratory and such a complete program of research work. It has pioneered in this field for 25 years. The results have been good up to now, but the possibility of proper expansion of the scope and quality is definitely limited by an organizational defect which places the responsibility for obtaining research funds in the hands of a Research Finance Committee formed each year by the chairman of the Committee on Research. This causes a discontinuity of policy and action, with very mediocre financial returns, the overall result being that practically all the research money comes from members' dues or from net balances from our publications.

Right now, while we are preparing the ground work for post war conditions, is the proper time to correct this defect in our organization. The most business like solution appears to be to place the responsibility for research fund solicitation in the directors of the Society, namely, the Council, who would naturally combine this with other business matters handled by the secretary. This would supply the necessary link to permit formulating a continuing and long range program which is absolutely necessary if our research work is to step forward to meet larger potentialities. Further, the chairman and other Committee on Research members would be freed to concentrate on their prime problems, *i.e.*, research and the use of the funds.

In closing, I wish to express my great appreciation of the

OFFICERS FOR 1945

C.-E. A. Winslow
New Haven, Conn.
President

A · S · H · V · E ·

Alfred J. Offner
New York, N. Y.
First Vice-President

W. A. Russell
Kansas City, Mo.
Second Vice-President

L. P. Saunders
Lockport, N. Y.
Treasurer

willing cooperation of the officers, the Council members and all the committee members, who have given freely of their time and talents under these stressful, wartime conditions; and to thank Secretary Hutchinson, Director of Research Tasker and others employed by the Society for duties well performed.

It is quite apparent that our Society does have before it A Greater Future than Its Great Past.

Respectfully submitted,
S. H. DOWNS.

The Secretary read the report of the Council and L. P. Saunders, Treasurer, gave his report, and a detailed statement on the Society's financial condition was given by Dr. B. M. Woods, chairman of the Finance Committee (report of certified public accountant will appear in March Journal).

Report of Council

During the year 1944 the council held five meetings. The organization meeting was February 3, at the Hotel Pennsylvania, New York, at which President Downs announced his appointment of Council and Special Committees. Due to a vacancy on the Council, Brig. Gen. W. A. Danielson was selected to serve for the unexpired term of one year.

Secretary A. V. Hutchinson and Technical Secretary Carl H. Flink were reappointed; the certified public accountant was selected and the Council approved depositories for Society funds in New York, Brooklyn, and Toronto.

A membership campaign was planned, and the proposal was discussed for permanent headquarters for the Society which resulted in the appointment of a special committee to study the matter. At the newly organized Research Laboratory of the Society in Cleveland the Council met on April 30, and heard a report from President Downs regarding his visits to a group of 10 chapters and three other informal Society groups.

The program for the Semi-Annual Meeting at Grand Rapids was approved and regulations for the method of furnishing speakers recommended by the Chapter Relations Committee were approved. A renewal lease at the New York headquarters office was approved for a two-year period and a new five-year editorial contract with Keeney Publishing Co. was authorized.

A report on the current status of research work was made and the Council inspected the new Laboratory facilities and attended a reception sponsored by the Northern Ohio Chapter.

The New York Chapter contributed surplus from the 50th Annual Meeting for the establishment of a fund for permanent building for the Society and the Council created a building fund.

At Grand Rapids reports were given on the financial condition of the Society; an invitation was accepted to hold the 51st Annual Meeting in Boston, and the Membership Committee was complimented on its accomplishments in increasing membership. New rules for the establishing of Society Codes and Standards were adopted.

Five nominations for three-year term on the Committee on Research were selected.

Petitions for the organization of five chapters were acted upon during the year and new chapters were established, Rocky Mountain in Denver, Central Ohio in Columbus, Memphis, Utah in Salt Lake City, and Central New York in Syracuse.

On October 16 the Council met at Columbus, and participated in the Charter Meeting of the Central Ohio Chapter.

A budget for the fiscal period November 1, 1944, to October 31, 1945, was adopted with an estimated income of $205,085.00 and an indicated expenditure of $210,105.00. Fare for Chapter Delegates and Council Members attending the Annual Meeting in Boston was authorized. In accordance with the Constitution, the Council waived the dues of men in the Service during 1945 and established a special service fee for those who desired to receive the Society's publications.

During the year at each meeting the Council acted upon resignations submitted, and cancelled the membership of those who were in arrears.

Respectfully submitted,
THE COUNCIL.

L. F. Collins was introduced and presented his paper on Studies of the Mechanism of Solution of CO_2 in Condensates Formed in the Steam Heating Systems of Buildings (published in January 1945 Journal Section, Heating, Piping & Air Conditioning). Dr. D. S. McKinney gave the paper on Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam Heating Equipment which he prepared with J. J. McGovern, C. W. Young and L. F. Collins (published in this issue, see p. 97). E. B. Watson then presented the two papers on the Summer Weather Data and Sol-Air Temperature—Study of Data for New York and Lincoln, Nebr., which he presented for himself and Prof. C. O. Mackey (data on New York published in November 1944 Journal Section; data on Lincoln published in January 1945 Journal Section, Heating, Piping & Air Conditioning).

(Complete Proceedings of the 51st Annual Meeting will appear in March Journal Section.)

C. S. Koehler, New York, N. Y., gave a report for the Tellers of Election for the Officers and Committee on Research as follows:

Ballots for Officers

President—C.-E. A. Winslow.....1161
1st Vice-President—Alfred J. Offner.....1163
2nd Vice-President—W. A. Russell.....1160
Treasurer—L. P. Saunders.....1165

Members of Council (three-year term)

W. A. Danielson.....1161
H. R. Roth.....1165
Ernest Szekely.....1162
B. M. Woods.....1162
(scattering votes for other candidates)

Committee on Research (three-year term)

R. M. Conner.....1165
John A. Goff.....1165
F. W. Hutchinson.....1164
W. E. Zieber.....1162
(scattering votes for other candidates)
Total Ballots Received.....1242
Total Legal Ballots.....1165

W. A. Danielson
Memphis, Tenn.

H. R. Roth
Toronto, Ont., Canada

Ernest Szekely
Milwaukee, Wis.

B. M. Woods
Berkeley, Calif

SUMMARY OF LOCAL CHAPTER MEETINGS

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Central Ohio	Dec. 18	Air Conditioning	L. T. Avery, Pres., Avery Engrg. Co., Cleveland, Ohio	Question and Answer period followed	36	0.70
				H. R. Allonier and W. M. Myler, Jr., were appointed as Repr. and Alternate on Nominating Committee; J. D. Slemmons and A. I. Brown as Delegate and Alternate to attend 51st Annual Meeting in Boston		
Cincinnati	Jan. 9	An All Year Around Gas Fired Air Conditioning Unit	John Gilbreath, Servel, Inc.	Pres. Sutfin announced the death of Herbert Kitchell, a past president of Michigan Chapter	30	0.61
	Dec. 12	The Engineer Btu's Effect on Political Forces	Brig.-Gen. W. A. Danielson, Memphis, Tenn.	It was voted that the last five Past Presidents be appointed to serve as Nominating Committee	28	0.59
	Nov. 30	Cincinnati Chapter and guests were taken on inspection tour of the Wright Aeronautical Corp. Plant at Lockland		A special trip was made through the water softening plant and the power houses, which was of special interest	28	
Delta	Dec. 12	Annual Business Meeting Pres. Cressy discussed subject of joint meetings with other engineering groups	G. C. Kerr and L. K. Nelson were elected Chapter Delegate and Alternate; they were also appointed Rep. and Alternate on Nominating Committee	Nominating Committee was appointed as follows: Messrs. Cressy, Dudley, May, Kerr and Gamble	23	0.63
Golden Gate	Jan. 3	Experiences with Performance of Ventilating and Air Conditioning Equipment on Various Types of Navy Craft Operating in South Pacific	Lieut. Comdr. John Everetts, Jr.	Lieut. Comdr. Walter Welham, Navy Medical Service, predicted a promising future for air conditioning in the Navy and elsewhere	46	0.41
	Dec. 5	Hydro (film depicting hydroelectric power generation and use from stream to house) B. W. Ela, College of Engineering, University of California, expressed appreciation for the Guides sent to him	Presented by J. A. Hill, Engr., Pacific Gas & Electric Co.	C. L. Peterson and R. B. Holland were appointed Repr. and Alternate on Nominating Committee, and as Chapter Delegate and Alternate Pres. Peterson announced retirement of M. I. Blumenthal, Engr. Maritime Commission, Oakland, who presented an interesting word picture of his experiences over a period of 52 years.	29	0.36
Illinois	Dec. 11	Fuel Conservation	Joseph Harrington, Advisory Engr., Northern Illinois Coal Corp., Chicago	John Howatt described the organization and objectives of Nat'l Fuel Efficiency Program	72	0.46

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Iowa	Jan. 2	The Future of Electronics in A.C. Controls	John Haines, Mgr., Htg. and A. C. Controls Div., Minneapolis-Honeywell Regulator Co.	M. L. Todd and F. E. Triggs were elected as Delegate and Alternate to Annual Meeting	26	
	Dec. 12	Report on Activities of ASHVE Committee to Draw Up an Enabling Act for Proposed State Building Code	Meryl Todd reported for Committee	The Committee will recommend passage of an act which provides that the Governor appoint two engineers, two architects, two contractors, and two lay members as the Code Committee	14	
Manitoba	Dec. 7	Elementary Design Forced Warm Air Heating	O. Hatch, Clare Bros., Ltd., Western	Discussion followed. Einar Anderson and F. T. Ball were appointed Delegate and Alternate to Annual Meeting in Boston	17	
Massachusetts	Dec. 19	Use of Fiberglas for Insulation and Other Purposes	C. H. Soderberg, New England Branch Mgr., Owens Corning Fiberglas Corp.		30	0.53
Michigan	Dec. 11	The Vernatherm, a New Thermostatic Development	R. L. Campbell, Detroit Lubricator Co.	"Here Is China," a film, was then shown	48	0.45
Minnesota	Jan. 12	The Post-War Trend to Central Steam Public Utilities for Heating	Robert L. Fitzgerald, Vice-Pres.-Gen. Mgr., Duluth Steam Corp.	Pres. Legler called upon members to introduce their guests	58	
	Dec. 8	Gas-Fired Year Around Air Conditioner	Mr. Knighton and Al Lee, both of Servel, Inc.	Pat Boyer, Mgr., Minneapolis Gas Light Co., introduced the speakers	204	2.15
Montreal	Dec. 11	Annual Meeting Election of Officers	Pres., A. B. Madden; Vice-Pres., T. H. Worthington; Secy., Leo Garneau; Treas., J. B. Dykes. Bd. of Gov., Messrs. Peart, Hamlet, Timmins, Twizell, Wormley	Pres. A. M. Peart announced he would present identification buttons to the Chapter to be worn by members at monthly meetings Program of moving pictures and entertainment followed	47	
Nebraska	Dec. 5	Daylight Engineering in the Home of Tomorrow	Roy W. Anderson, Kansas City, Mo.	Talk was illustrated by means of slides	20	1.42
Northern Ohio	Dec. 11	Fuels of the Future	Ralph A. Sherman, Supvr. Fuels Div., Battelle Memorial Institute, Columbus	R. M. Conner spoke briefly on gas fuel	54	0.35
		Instruments Used in the Analysis of Flue Gases	G. L. Tuve, Chairman, ASHVE, Committee on Research, Cleveland	Introduced by John James		
North Texas	Dec. 18	Christmas Party Election of Officers	Pres., E. T. Gessell; Vice-Pres., E. J. Stern; Secy.-Treas., C. R. Gardner. Bd. of Gov., L. C. McClanahan, W. H. Moler	Pres. McClanahan announced selection of M. I. Brown as Nominating Committee Repr., and Chapter Delegate. R. K. Werner as 1st Alternate and L. C. McClanahan as 2nd Alternate	72	1.57

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Oklahoma	Dec. 11	An All Year Air Conditioning Unit and Its Application to Residential and Small Commercial Installations	Michael P. Noll, Application Engr., Air Conditioning Div., Servel, Inc.	Discussion	23	
Ontario	Dec. 4	Something New in House Heating Controls	W. H. Evans, Gen. Mgr., and V. J. Jenkinson, Sales Engr., Minneapolis - Honeywell Regulator Co., Toronto		94	0.41
Pacific Northwest	Dec. 14	Landings on Tarawa and the Mariannas in the Pacific Campaign (film)	Sgt. Berg, Marine Corps, gave a vivid description of the film		16	0.20
Philadelphia	Dec. 14	The Anthratube	Dr. Raymond C. Johnson, Anthracite Institute	Dr. Johnson described the new method of burning anthracite coal Question and Answer period followed	200	
Pittsburgh	Jan. 8	A Panel Discussion of Technique of Operation of Controls (The Chapter *did not* pay $57.00 in War Bonds if the masters failed to answer the questions)	Jack Tracy (as Clifton Fadiman), Mr. Arnold (as F. P. Adams) and Mr. Smyers (as John Kiernan)	Mr. Tracy outlined the beginning of the thermostat; Mr. Arnold gave a summary of the pneumatic controls; Mr. Smyers summarized the wiring of the present controls for the average home	53	0.53
	Dec. 11	New Development in Air Conditioning for Multi-Storied Buildings.	N. E. Bueter, Product Specialist, Carrier Corp.	D. W. Loucks was appointed Chapter Delegate and T. F. Rockwell Representative on Nominating Committee	43	0.31
Rocky Mountain	Nov. 1	Application of Electronics and the Precipitron in Air Conditioning	L. A. Goalby, Local Mgr., Westinghouse Mfg. Co., assisted by H. M. Coulson, Sr., and H. M. Coulson, Jr.	Pres. McCabe announced the appointment of the various Chapter Committees	42	0.79
St. Louis	Dec. 5	Package Heat — Present and Future	D. J. Jones, Vapor Car Heating Co., Chicago	A lively discussion followed	35	0.52
South Texas	Nov. 15	Radiant Heating for Post War Construction	C. A. Hawk, A. M. Byers Co., Pittsburgh, Pa.	Pres. Barnes announced appointment of James A. Walsh to represent Chapter at Annual Meeting	39	
Southern California	Dec. 13	Recent Developments in Acoustics	Dr. Vern O. Knudsen, Dean of Graduate Div. and Professor of Physics, University of California, Berkeley	L. R. O'Rear gave an interesting report on his visit with the New York Chapter members	54	0.72
Utah	Dec. 18	Charter Meeting Heating and Ventilating as Applied to the B-29 Super Fortress	Prof. E. O. Eastwood, Past President of ASHVE, Seattle, Wash., presented the charter, which was acknowledged by J. T. Young, Jr. Professor Eastwood.	Officers were elected as follows: Pres., H. G. Richardson; Vice-Pres., J. T. Young, Jr.; Secy-Treas., Earl V. Gritton. Bd. of Gov., D. B. Holford, Alfred Richeda, R. C. Brown, C. E. Murdock	33	0.77

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
ashington, D. C.	Dec. 13	Importance of Research	Cyril Tasker, Dir. of Research, ASHVE Research Laboratory, Cleveland	Interesting Question and Answer Period followed	37	0.29
estern Michigan	Jan. 8	Rating and Performance of Warm Air Furnaces	Prof. A. P. Kratz, University of Illinois, Urbana, Ill.	Illustrated with slides S. H. Downs introduced Lt. R. Blanchard, U. S. Air Forces, who told what he could of his work	95	1.58
	Dec. 11	Radiant Heating	G. B. Coffey, A. M. Byers Co., Pittsburgh	An interesting discussion followed	40	0.66
estern ew York	Dec. 20	Annual Christmas Party	Sherman Strouse, Joseph Davis and David Mahoney provided the fun and amusement	Fred Moesel was appointed Chapter Delegate and Sherman Strouse Representative on Nominating Committee	79	
isconsin	Dec. 18	Modern Marvels in Electrical Heating	William H. Wagner, Industrial Htg. Engr., Wisconsin Electric Power Co.	E. W. Gifford and J. R. Vernon submitted Committee reports	40	0.67

*The attendance ratios shown represent the meeting attendance divided by the Chapter membership. These will be useful as a rtial indication of interest shown by local chapter members in various types of subjects programmed by other local chapters and ay be helpful in deciding on subjects for other chapter meetings.

. M. WYLIE DIES AT 58

Howard M. Wylie, a member of e ASHVE for 28 years and forer vice-president in charge of les of the Nash Engineering Co., uth Norwalk, Conn., died on hristmas Day at his home, 51 lmwood Avenue, South Norwalk, fter a long illness. He was born in oughkeepsie, N. Y., July 12, 1886.

Mr. Wylie received a B. S. degree om New York University in 1906 d an M. E. in 1908. He had rved as a design and erection gineer with the Westinghouse-hurch-Kerr Co., an erection engier with Bliss & Griffiths and the irebound Box Corp., secretary of e Howard Automobile Co., design gineer for the Roland Gas and ectric Co., and sales engineer for e Bishop-Babcock Co. In 1915 he ined the New York office of the ash firm, as a sales engineer, and er became manager of the office.

In 1919 Mr. Wylie came to South orwalk as general sales manager. e was elected a director in 1921, sistant secretary in 1922, and ce-president in charge of sales e next year. Mr. Wylie retired as ce-president and as director in 42.

Howard M. Wylie

Mr. Wylie was a Registered Professional Engineer in both New York and Connecticut, was a member of the *American Society of Mechanical Engineers*, the *Connecticut Society of Professional Engineers*, and the Engineers Club in New York City. He also belonged to the Zeta Psi Club.

Mr. Wylie leaves a widow, Mrs. Alice Hutchinson Wylie; a daughter, Miss Virginia Lawrence Wylie of New York and South Norwalk; a sister, Miss Jane D. Wylie of New York; and two brothers in the Army, Lieut. Col. David R. Wylie of Washington, D. C., a chaplain, and Major Robert S. Wylie, now overseas. The Officers and Council of the Society extend their deepest sympathy to the family in their bereavement.

FRED C. BLACK, LIFE MEMBER, DIES IN CHICAGO

Word has been received of the death of Fred C. Black, Life Member of the Society, on January 6, 1945. Mr. Black was born on May 16, 1867, in Rochester, N. Y.

To the many architects, engineers, journeymen, steamfitters, and heating contractors in and around Chicago he was known as "Fred." He enjoyed an enviable reputation for his knowledge of the steamfitting industry, his integrity, genial disposition and practical instincts.

In 1891 he worked as a steamfitter with Bill Graves, and was manager of the M. H. Crane Estate, piping contractors, Chicago, for many years. In 1926 he took over the business in his own name.

He had been a member of the Chicago Master Steamfitters Association for over 35 years, served as its president in 1926-27, and was actively serving that association as a member of the arbitration committee until shortly before his death.

He was a charter member of the Building Construction Employers Association, had served on the executive committee for 10 years and

as vice-president for a number of years.

Mr. Black joined the Society in 1919 and was one of the few honored by the Council of the Society in 1937 when Life Membership was conferred upon him.

The Officers and Council of the Society extend their sincere and heartfelt sympathy to his family.

COMMANDER HOUGHTEN DIES SUDDENLY

Members who attended the 51st Annual Meeting of the Society in Boston were greatly shocked to receive the report of the passing of Comdr. F. C. Houghten on Thursday, January 25. He attended the meeting in Boston where he greeted many old friends, and participated in the Committee activities. One of his last official acts was to accept appointment as a member of the Guide Publication Committee.

On Wednesday evening he was stricken and was rushed to the Chelsea Naval Hospital where he died on Thursday at the age of 56.

Commander Houghten had served as Director of the Society's Research Laboratory for nearly 20 years prior to his entry in the Service. He was commissioned in the Naval Reserve in 1942, and was attached to the Bureau of Ships, and later his assignment was with the Research Division of the Navy, Bureau of Medicine and Surgery.

The members of the Society will greatly miss his genial presence through associations at Society and chapter meetings. He had a distinguished career in the field of research, particularly as it related to heating, ventilating, and air conditioning, and his name is indelibly recorded as a pioneer in the studies that determined conditions of human comfort. For his work as an outstanding research investigator the Society presented its highest honor, the F. Paul Anderson Medal in 1944 at the 50th Annual Meeting of the Society, and Olivet College conferred an honorary degree of Doctor of Science at its Founders Day in 1941.

In the citation for the Anderson Medal Commander Houghten was honored "for outstanding research over a long period of years in the fields of heating, ventilating and air conditioning, resulting in distinct benefits to the public and the nation; for advancement of the knowledge of the physiological reactions of persons to their environment; and for the careful presentation of technical data readily adaptable to general use in engineering."

Comdr. Ferry C. Houghten
U. S. N. R.

Ferry C. Houghten was born February 18, 1888, at Troy, Mich., and received an A.B. degree from Olivet College, Olivet, Mich., in 1913, and an M. S. degree from the University of Washington, Seattle, Wash., in 1915. After graduation from Olivet he taught physics at the University of Washington, and science in West Coast High Schools until 1918, when he joined the U. S. Bureau of Mines at Pittsburgh, Pa., and had charge of the Physical Laboratory of Research. He worked on problems of heat transmission and boiler testing, and during World War I had charge of investigations on heating and cooking devices for the War Department. In November 1920 he was appointed on the staff of the ASHVE Research Laboratory, then located at the Bureau of Mines, and for the next four years was in charge of heat transmission investigations. Among the subjects on which he worked were, heat losses from buildings, pipe sizes for steam heating, air leakage around windows and doors, study of physical reactions of human beings in various atmospheric conditions, and many others.

He was then called to the headquarters of the Society as Secretary and served during 1924 and 1925. In September 1925 he was appointed as Director of the Society's Research Laboratory and returned to Pittsburgh.

For a period of nearly 20 years Commander Houghten had charge of the work of the Society's Laboratory, and issued many reports which he presented to the Society at Annual and Semi-Annual Meetings and which appear in the Society's Transactions. In addition he contributed many scientific papers to engineering and medical journals, and he served on many inter-Society committees as a representative of the Society.

He joined the Society in 1921 and was also active in the work of the local Chapter in Pittsburgh, serving as its president in 1931.

The sudden death of Commander Houghten cuts short a career that held promise of many more important contributions to the art and science of heating, ventilating, and air conditioning. His work exerted a powerful influence that was of international significance, and his long association in the Society had won him a legion of friends who mourn his passing.

Commander Houghten leaves his wife, three sons, Capt. Robert L. Houghten, a meteorologist in the Army Air Forces, Second Lieut. Richard H. Houghten, Army Air Forces, now a prisoner of war in Germany, and James W. Houghten, fireman third class, United States Maritime Service, now at sea, and a daughter, Mrs. Ruth Marion Shields.

Private services were held at 1:30 p. m. at Gawler's Funeral Parlor, Washington, D. C., January 30, and military services at 2:00 p. m. in Fort Meyer Chapel with interment in Arlington National Cemetery. Many representatives of Council, Advisory Council, Committee on Research, and of the Washington D. C., Chapter, were in attendance at the funeral services.

In tribute to the work of Commander Houghten, Pres. C.-E. A. Winslow said:

"The research work of the Society is its chief source of pride; and the development of its programs through the years was primarily due to the devoted services of Commander Houghten. No one, in its history, probably did more for the Society or more for the development of the basic data on which sound air conditioning practice must be based."

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 78 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by February 15, 1945, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
ADAMS, WILLIAM J., Estimator, Chicago, Ill.	S. L. Haas J. J. Philippi	W. E. Foskett A. O. May
ANDERSON, WILLIAM S., JR., Partner, Axeman-Anderson Associates, Williamsport, Pa.	J. E. Axeman M. F. Blankin	A. E. Kriebel H. H. Erickson
ARCHER, WILLIAM J., Engr., Howes & Whitaker, San Francisco, Calif.	R. B. Holland N. H. Peterson	C. E. Bentley H. V. Hickman
BAWDEN, LESLIE A., Asst. Tech. Mgr., Spirax Manufacturing Co., Ltd., Beechmount, Cheltenham, Glouces, England.	T. N. Adlam G. E. Smith	*L. G. Northcroft H. C. Barratt
BEIRN, JOHN B., Sales Engr., American Radiator & Standard Sanitary Corp., Springfield, Mass.	P. D. Bemis E. C. Marsden	W. Roeder J. W. Brinton
BRIDGMAN, ROBERT L., Sales, American Radiator & Standard Sanitary Corp., Washington, D. C.	M. F. Hoppe H. K. Kugel	J. W. Markert C. T. Sluder
BROWN, J. MASON, Engr., Worthington Pump & Machinery Corp., Harrison, N. J.	W. A. Danielson J. P. Linton	Robert Reis Fred Boxall
COCHRAN, LUCIUS D., Engr., American Welding & Manufacturing Co., Warren, Ohio.	J. E. Wilhelm Dennis Boggs	L. G. Powers L. E. Seeley
DEBRA, FREDERICK B., Owner, Fred B. DeBra Co., Cincinnati, Ohio.	G. B. Houliston T. D. Boyd	K. A. Wright H. E. Sproull
DUDLEY, WILLIAM H., JR., Dist. Mgr., The Trane Co., New Orleans, La. *(Advancement)*	Cary Gamble N. J. Helwick	L. V. Nelson W. P. Oster
DWYER, PATRICK, Draftsman, Richard Crittall & Co., Ltd., London, England.	G. E. Smith M. Drury	G. M. Peach G. A. Shaw
EDWARDS, GEORGE B., Plbg. & Htg. Contr., Niagara Falls, N. Y.	J. J. Landers B. C. Candee	S. W. Strouse G. E. Adema
ERICKSON, GORDON A., Acting Mgr., Sales Engrg. Dept., Wood Conversion Co., St. Paul, Minn.	R. E. Backstrom William Sturm	Lyman Gross O. L. Lilja
FARNUM, WARREN S., Engr., Westinghouse Electric Elevator Co., Boston, Mass.	K. L. Mytinger G. B. Gerrish	C. W. Kniffin H. B. Babcock
FAVRET, LOUIS E., Pres. & Gen. Mgr., Williamson-Favret Furnace Co., Columbus, Ohio.	A. T. English T. R. Walker	W. M. Myler, Jr. A. W. Williams
FENSTERMAKER, SIDNEY E., JR., Sales & Design Engr., S. E. Fenstermaker & Co., Indianapolis, Ind.	G. B. Supple C. H. Hagedon	S. E. Fenstermaker H. V. Alexander
FLEISHER, WALTER L., JR., Mgr., Air & Refrigeration Corp., Atlanta, Ga.	J. L. Bradshaw W. J. McKinney	C. L. Templin L. L. Barnes
FREEMAN, CASSIUS W., Chief Designer, Paul D. Bemis, Hartford, Conn.	P. D. Bemis T. J. Converse	J. R. Smak L. O. R. Clark
GEISSENHAINER, LOUIS R., Owner, L. R. Geissenhainer, Boston, Mass.	W. T. Bride E. L. Blair	R. C. Colman E. H. Seelert
GIRGIS, SOBHI, Engr., Carrier Egypt, Cairo, Egypt.	M. Brakha M. E. Tahry	Kamal Ezz-El-Din *Daniel Grunberg
GRAY, FRANK L., JR., Engr., Carrier Corp., Chicago, Ill.	H. E. Rex H. Lauterbach, Jr.	*J. H. Erb *H. C. Hoffmann
GREGORY, HENRY D., Htg. Dept., Hendrie & Bolthoff Manufacturing & Supply Co., Denver, Colo.	J. H. McCabe F. L. Adams	G. D. Maves F. F. Dodds
HAAS, EMIL, JR., Mgng. Partner, Natkin & Co., Kansas City, Mo. *(Advancement)*	Henry Gould M. M. Rivard	D. M. Allen W. A. Russell
HARTWIG, WALTER J., Mech. Engr., Service Command Eng., Federal Bldg., Omaha, Nebr.	B. G. Peterson D. D. Williams	D. E. McCulley C. A. Carter
HAUSSER, FRED L., Partner, Ward & Hausser, Hartford, Conn.	E. R. Clement Winfield Roeder	L. O. R. Clark C. J. Lyons
HICKEY, C. B., Sales Engr., Hendrie & Bolthoff, Denver, Colo.	F. W. Dodds L. R. O'Rear	F. L. Adams J. H. McCabe
HIGH, A. K., Owner, Automatic Heating Service Co., Norristown, Pa.	R. C. Johnson R. A. Protheroe	J. M. Kipe J. S. King
HILLARD, HENRY F., Chief Engr., Mountain Fuel Supply Co., Salt Lake City, Utah.	E. D. Smith H. G. Richardson	D. R. Wilde E. V. Gritton
HINGSTON, GEORGE N., Exec. Secy., Metal Window Institute, Cheltenham, Pa.	J. O. Kirkbride H. M. Parent	R. S. Mizener G. W. A. Kappel
HUTCHISON, ALLEN, Chief Engr., Berkeley Hotel, Montreal, Que., Canada.	T. H. Worthington A. M. Peart	H. T. Doran F. J. Friedman

*Non-member.

JANSSEN, FRED, Engr., Public Service Company of Colorado, Denver, Colo.	F. L. Adams G. D. Maves	J. H. McCabe G. F. Adams
JUNGELS, ALTON J., Constr. Engr., R. C. A., Camden, N. J.	R. S. Mizener G. W. A. Kappel	J. O. Kirkbride H. M. Parent
KELLEY, R. P., Mfrs. Agent, Miami, Fla.	B. A. Thomas H. G. Carter	*W. J. Snyder *W. R. Ganger
KENNEDY, DON P., Engr.-Estimator, Sans Co., Jamestown, N. Y.	W. R. Stockwell C. F. Newport	Martin Weil Herman Seelbach, Jr.
KINZER, OSBORN A., Capt., Corps of Engineers, U. S. Army, Ft. Douglas, Utah.	R. H. East A. A. Maycock	E. V. Gritton J. L. Ashton
KURTH, FRANZ B., JR., Asst. Plant Mgr., Anemostat Corporation of America, West Hartford, Conn.	Fritz Honerkamp V. F. Self	F. J. Kurth A. B. Hewett
LOKEY, EDGAR R., Dist. Mgr., Norman S. Wright & Co., Portland, Oregon.	W. B. Morrison B. W. Farnes	W. J. Widmer E. C. Willey
MACGANN, LLOYD S., Engr., Minneapolis-Honeywell Regulator Co., Boston, Mass.	W. G. Jennings T. P. Mandell	J. P. Licandro J. W. Brinton
MACKENZIE, JOHN M., Field Engr., Aget-Detroit Co., Ann Arbor, Mich.	R. H. Berryman W. N. Witheridge	T. H. Mabley E. F. Hyde
MCCARTHY, FRANCIS W., Dist. Mgr., Minneapolis-Honeywell Regulator Co., Des Moines, Iowa.	T. R. Johnson M. L. Todd	B. E. Landes C. H. McGuiness
MCGUIRE, JAMES W., Owner, Air Distribution & Controls, New York, N. Y.	H. J. Ryan B. E. Tiltz	Peter Franck C. E. Lewis
MCQUITTY, ROY M., Steam Utilization Engr., Union Electric Company of Missouri, St. Louis, Mo.	B. C. Simons W. J. Oonk	L. R. Szombathy B. L. Evans
MUEHLIG, ELMER J., Constr. Engr., F. W. Woolworth Co., Denver, Colo.	O. G. Ward W. M. Larimer	E. A. Froese J. H. McCabe
MENCH, JOHN G., Mech. Engr., James Stewart Corp., Chicago, Ill.	W. L. Hand C. M. Burnam, Jr.	C. E. Price J. J. Philippi
MOONEY, BERNARD P., Designer & Supvsr. of Htg. Installations, Minneapolis, Minn.	L. K. Reisberg Lyman Gross	C. E. Wiser F. H. Schernbeck
MOLTZ, BERNARD S., Pres., Potomac Sheet Metal Co., Inc., Takoma Park, Md.	Frank Porter A. B. DeVore	B. A. Russell W. E. Kingswell
NYSTROM, PAUL E., Archt. & Partner, Law, Law, Potter & Nystrom, Madison, Wis.	M. W. Bishop J. A. Cutler	H. W. Schreiber F. G. Weimer
PETTENGELL, JOHN M., Dist. Repr., American Air Filter Co., Inc., Boston, Mass.	E. G. Carrier T. P. Mandell	J. W. Brinton J. P. Licandro
PETREK, THEODORE R., Sales Mgr., L. J. Wing Manufacturing Co., New York, N. Y.	H. S. Wheller R. A. Wasson	Harry Schmidt E. J. Ritchie
PIETSCH, HERMAN A., Chief Engr., Dravo Corp., Pittsburgh, Pa.	*R. M. Rush P. C. Strauch	R. D. Darrah C. M. Humphreys
PORTER, H. MERWIN, Pres., Belden Porter Co., Minneapolis, Minn.	Lyman Gross J. A. Craig	C. E. Wiser F. H. Schernbeck
PRICE, ALBERT Z., Pres. & Treas., The A. Z. Price Co., Inc., Charlotte, N. C.	R. V. Sisk James MacDonald	E. H. Brandt, Jr. E. S. DeWitt
RAINEY, NORMAN W., Air Cond. Engr., Danforth Co., Pittsburgh, Pa.	T. F. Rockwell E. C. Smyers	C. M. Humphreys E. C. Hach
REH, HERBERT C., Layout Man & Supvsr., Air-Conditioning Utilities Co., Brooklyn, N. Y.	H. W. Fiedler J. A. Heller	H. S. Birkett *Herman Gunther
RIEHL, WILLIAM L., Asst. to Vice-Pres., The Union Fork & Hoe Co., Rome, N. Y.	J. W. Stevens C. M. Ashley	Milner Noble W. L. Lynch
ROBISON, D. J., Engr., Mountain Fuel Supply Co., Salt Lake City, Utah.	E. D. Smith H. G. Richardson	E. V. Gritton D. R. Wilde
ROMER, WILLIAM H., Constr. Engr., J. F. Higgins Heating Co., Providence, R. I.	C. R. Swaney F. H. Brigham	J. F. Higgins G. H. Potter
ROTH, HERMAN P., Design Engr., AiResearch Manufacturing Co., Los Angeles, Calif.	J. S. Earhart R. A. Lowe	Leo Hungerford J. F. Park
SCHAARSCHMIDT, KARL F., Partner, Majestic Heating Co., Detroit, Mich.	M. B. Shea W. H. Old	F. X. Marzolf R. D. Randall
SCHLENK, HUGO, JR., Engr., The Northwest Paper Co., Cloquet, Minn.	H. E. Gerrish F. B. Rowley	R. E. Gorgen E. F. Bell
SCHWITZER, LOUIS H., JR., Exec. Vice-Pres., Schwitzer-Cummins Co., Indianapolis, Ind.	*C. C. Merz John Roland	*R. C. Fox W. T. Miller
SHIELDS, ROY W., Engr., Samuel R. Lewis, Chicago, Ill.	S. R. Lewis E. P. Heckel	S. I. Rottmayer J. J. Hayes
SHULL, LEON F., Price Specialist, Office of Price Administration, Denver, Colo.	Elmo Hall C. B. Ward	F. L. Adams J. H. McCabe
SINGLETON, WILLIAM H., Vice-Pres., Mehring & Hanson Co., Washington, D. C.	M. F. Rather W. C. Jones	J. H. Hanlein M. F. Hoppe
SMITH, BERNARD, Tech. Htg. Advisor, Spirase Manufacturing Co., Ltd., Cheltenham, Glouces., England.	T. N. Adlam G. E. Smith	*L. G. Northcroft *H. C. Barratt
SMITH, ELWYN L., Unit Head, U. S. Engineer Dept., Corps of Engineers, War Department, Kansas City, Mo.	D. M. Allen *L. D. McDonald	*R. L. Gillis E. K. Campbell
SPRINGER, JOSEPH J., Owner, Oneida Supply Co., Oneida, N. Y.	D. D. Wile W. L. Lynch	C. M. Ashley J. W. Stevens
STEPHAN, CHARLES O., Owner, Stephan & Lambert, Pueblo, Colo.	J. H. McCabe J. J. Johnson	A. W. Cooper W. M. Larimer
SWEENEY, GEORGE J., Vice-Pres., Air Devices, Inc., New York, N. Y.	H. J. Ryan Joe Wheeler, Jr.	Peter Franck M. F. Rather
SWEPSTON, M. M., Pres. & Mgr., Atlas-Butler Furnace, Inc., Columbus, Ohio.	A. T. English T. R. Walker	W. M. Myler, Jr. A. W. Williams
VAN WAGENEN, EDWARD, Mech. Engr., U. S. Naval Air Station, Jacksonville, Fla.	M. T. Crumley K. C. Griest	Walter Denson, Jr. F. J. Beckwith
VINTHER, PERCY N., Owner, Zumwalt & Vinther, Dallas, Texas.	Claude Yost E. T. Gessell	J. A. Ray E. J. Stern
WAGNER, HARLAN C., JR., Draftsman, Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	R. V. Terry *Chester Ashby	*J. Sasland *H. A. Ross-Clumis
WATT, ROBERT D., Pres., Electrol Oil Burner Corp., Seattle, Wash. (*Advancement*)	E. O. Eastwood R. E. Moore	*H. W. Beecher *H. E. Sovereign
WATTS, EDWARD J., Application Engr., Worthington Pump & Machinery Corp., Salt Lake City, Utah.	E. D. Smith E. V. Gritton	H. G. Richardson D. R. Wilde
WEDEBROCK, ARCH L., Staff Engr., Johns Manville, New York, N. Y.	A. R. Herske P. F. McDermott	W. W. Cullin Wharton Clay

WHEELER, ARTHUR G., Engr. & Exec., House Sheet Metal Co., Syracuse, N. Y.

WILLOUGHBY, JOSEPH D., Owner, F. W. Willoughby Co., Denver, Colo.

J. W. Stevens
C. M. Ashley

N. H. Brickham
George Adams

D. D. Wile
Milner Noble

L. A. Michael
J. H. McCabe

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8 of the By-Laws, the following list of candidates elected:

MEMBERS

APPELT, J. E., Mgr., The Trane Co., Grand Rapids, Mich.

BAKER, C. H., Htg. & Vent. Engr., Snyder & McLean, Detroit, Mich. (*Reinstatement*)

BAKER, H. A., Vice-Pres., W. B. Connor Engineering Corp., New York, N. Y.

BAKER, H. C., Plant Engr., Aluminum Company of America, Monroe, Mich. (*Reinstatement*)

BARTON, K. L., Indus. Engr., The Foxboro Co., New York, N. Y.

BEMARKT, G. H., Mgr., Htg. Dept., N. O. Nelson Co., St. Louis, Mo.

BIERL, J. G., Vice-Pres., Schollman Bros. Co., Omaha, Nebr.

BLEIER, F. P., Research Dir., Ilg Electric Ventilating Co., Chicago, Ill. (*Advancement*)

BOWERS, C. L., Mgr., E. G. Sheet Metal Works, Hapeville, Ga. (*Advancement*)

BROOKE, B. B., Dist. Vent. Engr., The General Electric Co., Ltd., Kingsway, Cardiff, So. Wales.

CHAMPLIN, R. C., Air Cond. Engr., Timken Silent Automatic Div., Timken Detroit Axle Co., Detroit, Mich. (*Advancement*)

DAVIES, Charles, Pres., Davies Air Filter Co., New York, N. Y.

DAVIDSON, W. J., Application Engr., N. O. Nelson Co., Pueblo, Colo.

DEES, L. L., Owner, Kansas Sheet Metal Co., Topeka, Kans.

ELLIS, C. W., Engr., J. A. Walsh & Co., Inc., Houston, Texas.

EMBREE, E. G., Engr., Tompkins-Johnston Co., Charlotte, N. C.

FERRIS, A. F., Mech. Engr., Ferris & Hamig, St. Louis, Mo.

GABBERT, W. L., Dist. Sales Mgr., American Air Filter Co., Inc., Louisville, Ky.

GARNETT, WILLIAM, Mech. Engr., Frankford Arsenal, Philadelphia, Pa.

GOODHUE, B. C., Refrig. Engr., W. A. Case & Sons Manufacturing Co., Syracuse, N. Y.

GRANT, R. A., Engr., McCrea Equipment Co., Washington, D. C.

GREINER, M. C., Field Engr., English & Lauer, Inc., Los Angeles, Calif.

GROSS, H. A., Dist. Mgr., Surface Combustion, Minneapolis, Minn.

HEYWOOD, W. J. T., Jr., Cons. Engr., Henri B. Van Zelm, Hartford, Conn.

HILLEN, W. G., Asst. Sales Mgr., Carrier Corp., Syracuse, N. Y. (*Advancement*)

HOLBROOK, J. A., Research Engr., Century Engineering Corp., Cedar Rapids, Iowa.

HOROWITZ, HARRY, Sales Engr., Albany, N. Y.

HULL, L. M., Sales Mgr., Hammel Radiator Engineering Co., Los Angeles, Calif.

JARRETT, R. F., Tech. Dir., Flexaire Heaters, Ltd., London, England.

KUGLIN, C. R., Chief Mech. Engr., Montgomery Ward & Co., Chicago, Ill.

LAMSON, F. S., Owner, F. S. Lamson Co., Minneapolis, Minn. (*Reinstatement*)

LEE, B. H., Mance Corp., New York, N. Y. (*Advancement*)

MATHEY, N. J., Sunflower, Kans. (*Reinstatement*)

MATTIMORE, J. D., Research Dir., Tube Turns, Inc., Louisville, Ky.

MORGAN, G. R., Partner & Dept. Head, J. E. Sirrine & Co., Greenville, S. C.

NUGENT, A. W., Spec. Repr., McQuay, Inc., Washington, D. C.

PETERSON, R. J., Supvsr. of Research & Development, Utility Fan Corp., Los Angeles, Calif.

PHELAN, J. H., Engr. & Estimator, G. W. Cunningham Co., Columbia, Conn.

REIL, H. W., Engr. & Mgr., Conditioned Air, Inc., Atlanta, Ga.

SINES, C. F., Sr. Naval Archt., Puget Sound Navy Yard, Bremerton, Wash.

SMITH, R. H., Prop., Russell H. Smith Equipment Co., Columbus, Ohio.

STOFFER, G. H., Sales Engr., Carrier Corp., Detroit, Mich.

STREATER, W. A., Sales Repr., Modine Manufacturing Co., Atlanta, Ga.

TORRENS, G. B., Mech. Engr., The Jennison Co., Fitchburg, Mass.

TRACY, J. W., Sales Engr., Minneapolis-Honeywell Regulator Co., Pittsburgh, Pa.

TRIMBLE, J. I., Mgr., Janitrol Engrg. Dept., Surface Combustion, Columbus, Ohio.

WALTER, B. J., Sales Engr., R. L. Deppmann Co., Detroit, Mich.

WAY, N. C., Engr., Way Engineering Co., Houston, Texas.

WEAVER, CHANDLER, Sales Engr., Surface Combustion, Denver, Colo.

WEBB, JOHN S., W. D. Cashin Co., South Boston, Mass. (*Reinstatement*)

ASSOCIATES

ALBERT, W. J., Chief Draftsman, George C. Lewis, Philadelphia, Pa.

ARTRAN, CARLYLE, Engr., General Air Conditioning Corp., Los Angeles, Calif.

BILDERBACK, G. R., Comml. Supvsr., Advanced Refrigeration, Inc., Atlanta, Ga.

CALDWELL, W. J., Gen. Mgr., William J. Caldwell Co., Washington, D. C.

CHUR, C. H., JR., Mgr., W. A. Case & Son Manufacturing Co., Syracuse, N. Y.

CROSS, L. E., Gen. Supt., American Foundry & Furnace Co., Milwaukee, Wis.

FISHER, A. E., Kerr Machinery Co., Detroit, Mich. (*Reinstatement*)

FREYDER, G. G., Refrig. Engr., Commonwealth Edison Co., Chicago, Ill.

FRISSE, J. L., Owner, The Thermal Products Co., Cleveland, Ohio.

GIBSON, H. E., Owner, Gibson Sheet Metal Works, Muskegon, Mich.

GILBERT, I. W., Co-Owner, Gilbert & Knight Co., Utica, N. Y.

HALL, N. H., Supvsr., East Ohio Gas Co., Cleveland, Ohio. (*Reinstatement*)

HARRIS, H. J., Pres., Marion Oil & Service Corp., Mt. Vernon, N. Y.

HEAPHY, J. A., Owner, D. J. Heaphy & Son, Syracuse, N. Y.

HENRY, R. W., Salesman, W. B. Young Supply Co., Kansas City, Mo.

JOHNSON, H. K., Mgr., Htg. Dept., Brown Steel Tank Co., Minneapolis, Minn.

JUHL, E. F., Chief Engr., Thorpe Brothers, Inc., Minneapolis, Minn.

LAMBERT, E. G., Mgr., Building Maintenance Service, Inc., Dallas, Texas.

LEWIS, S. D., Mgr., Westinghouse Electric Elevator Co., Cleveland, Ohio.

MAPLE, C. W., Chief Draftsman, Avery Engineering Co., Cleveland, Ohio.

MCGOVERN, A. F., Dist. Mgr., Modine Manufacturing Co., Columbus, Ohio.

MCGRUER, A. E., Supvsr. of Stationary Boiler Plants, Canadian Pacific Railway Co., Toronto, Ont., Canada.

MCQUEEN, BOSTON, Engr., Hall-Neal Furnace Co., Indianapolis, Ind.

MERRYMAN, C. P., Owner, Merryman-Wilson Co., Union City, Tenn.

MILLIGAN, D. G., George G. Sharp, New York, N. Y. (*Reinstatement*)

MULHOLLAND, D. J., Supt., Consolidated Conditioning Corp., Dobbs Ferry, N. Y.

NORCROSS, I. F., Mech. Engr., E.L.E. Co., Los Angeles, Calif.

OLLESHEIMER, L. T., Factory Repr., Detroit, Mich.

QUIGLEY, M. E., Engr., Harris Bros. Plumbing Co., Minneapolis, Minn.

REIHER, HERMAN, Bldg. Supt., Baker Properties, Inc., Minneapolis, Minn.

ROBINSON, J. H., Mgr., B. A. Robinson Plumbing & Heating, Ltd., Toronto, Ont., Canada.

SANFORD, H. L., Owner, Sans Co., Jamestown, N. Y.

SAUNDERS, M. K., Pres., Kerby Saunders, Inc., New York, N. Y.

SEYMOUR, C. D., Pres. & Mgr., Seymour Plumbing & Heating Contractors, Ltd., Toronto, Ont., Canada.

SHERRER, J. W., JR., Htg. Engr., Equitable Gas Co., Pittsburgh, Pa.

STILLER, F. W., Minneapolis, Minn. (*Reinstatement*)

TAYLOR, E. P., Htg. & Plbg. Supt., Buckingham-Routh Co., Wallingford, Conn.

WAY, J. B., Mgr., Equipment Dept., Vipond, Tolhurst, Ltd., Montreal, Que., Canada.

WILSON, G. H., Sr. Engr., Atlas Electric Devices Co., Chicago, Ill.

WINTER, C. L., Stoker Distributor, Link-Belt Co., Grand Rapids, Mich.

YOVANOVICH, E. A., Expediter, Carnegie Illinois Steel Corp., Gary, Ind.

JUNIORS

CHASE, J. C., Lt., U.S.N.R., Brooklyn, N. Y.

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Atlanta: Organized, 1937. Headquarters, Atlanta, Ga. Meets, First Monday. President, I. B. Kagey, 611 Bona Allen Bldg., Atlanta 3. Secretary, M. F. DuChateau, Washington St. Viaduct. Atlanta 3.

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Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, L. V. Cressy, 423 Baronne St., New Orleans 13. Secretary, J. S. Burke, 317 Baronne St., New Orleans 9.

Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, C. L. Peterson, 2 Indian Rock Path, Berkeley. Secretary, James Gayner, 260 California St., San Francisco 11.

Illinois: Organized, 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, A. O. May, Room 925, 53 W. Jackson Blvd., Chicago 4. Secretary, C. M. Burnam, Jr., Room 1605, 6 N. Michigan Ave., Chicago 2.

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Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, W. W. Stuart, 417 9th St. Secretary, E. O. Olson, Iowa State College, Ames.

Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, D. M. Allen, 215 Pershing Rd., Kansas City 8. Secretary, R. E. Bade, 1102 Commerce Bldg.

Manitoba: Organized, 1935. Headquarters, Winnipeg, Man. Meets, Third Thursday. President, Einar Anderson, 152 Bannerman Ave. Secretary, F. T. Ball, 810 9th Ave., W., Calgary, Alta.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, D. M. Archer, 142 Federal St., Boston 10. Secretary, C. W. Larson, 184 Sycamore St., Roslindale.

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Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, W. H. Old, 1761 Forest Ave. W., Detroit 8. Secretary, A. E. Knibb, 1003 Maryland Ave., Detroit 30.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, F. W. Legler, 17 W. 28th St. Secretary, F. H. Schernbeck, 1057 10th Ave. S. E.

Montreal: Organized, 1936. Headquarters, Montreal, Que. Meets Third Monday. President, A. B. Madden, 1170 Beaver Hall Sq. Secretary, Leo Garneau, Room 832, Dominion Square Bldg.

Nebraska: Organized, 1940. Headquarters, Omaha. Meets, Second Tuesday. President, B. G. Peterson, 6235 Florence Blvd. Secretary, D. E. McCulley, 814 S. 14th St., Omaha 2.

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North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Third Monday. President, F. E. P. Klages, 1034 Jefferson Standard Bldg., Greensboro. Secretary, W. L. Hunken, 707 Guilford Bldg., Greensboro.

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Northern Ohio: Organized, 1916. Headquarters, Cleveland, O. Meets, Second Monday. President, D. L. Taze, 1302 Swetland Bldg., Cleveland 15. Secretary, R. H. Cutting, 3795 Glenwood Rd., Cleveland Heights.

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Ontario: Organized, 1922. Headquarters, Toronto, Ont. Meets, First Monday. President, A. S. Morgan, 156 Glenmanor Dr. Secretary, H. R. Roth, 57 Bloor St., W.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, E. C. Willey, Oregon State College, Corvallis. Secretary, G. H. Risley, 516 S. W. Oak St., Portland 4.

Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, M. N. Musgrave, 2019 Third Ave., Seattle 1. Secretary, J. D. Sparks, 7331 W. Green Lake Way, Seattle 3.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, A. C. Caldwell, 550 So. 40th St., Philadelphia 43. Secretary, J. O. Kirkbride, Fourth and Locust Sts., Philadelphia 6.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, T. F. Rockwell, Carnegie Institute of Technology, Schenley Park. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, J. H. McCabe, 1730 Glenarm St. Secretary, F. L. Adams, P. O. Box 840, Denver 1.

St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, G. B. Rodenheiser, 4431 Finney Ave., St. Louis 13. Secretary, B. L. Evans, 571 Stratford Ave., University City.

South Texas: Organized, 1938. Headquarters, Houston, Texas. Meets, Third Friday. President, A. F. Barnes, 602 Kirby Bldg., Houston 2. Secretary, B. P. Fisher, Box 92, Houston 1.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, Leo Hungerford, 2485 Wonderview Pl., Los Angeles 28. Secretary, Arthur Theobald, 336 North Foothill Rd., Beverly Hills, Calif.

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. President, H. G. Richardson, 1433 Harvard Ave. Secretary, E. V. Gritton, 2470 So. 15th East St.

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, J. W. Markert, 8506 Garfield St., Bethesda, Md. Secretary, A. S. Gates, Jr., 111 County Rd., Kensington, Md.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. D. Bratt, 2259 Stafford Ave., S. W., Grand Rapids 7. Secretary, Frank Harbin, Jr., 181 West 21st St., Holland.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, S. W. Strouse, 495 Franklin St., Buffalo 2. Secretary, G. E. Adema, 39 W. Balcom St.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, L. J. Haus, 3330 N. Richards St., Milwaukee 1. Secretary, M. W. Bishop, 261 W. Wisconsin Ave., Milwaukee 3.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1945 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

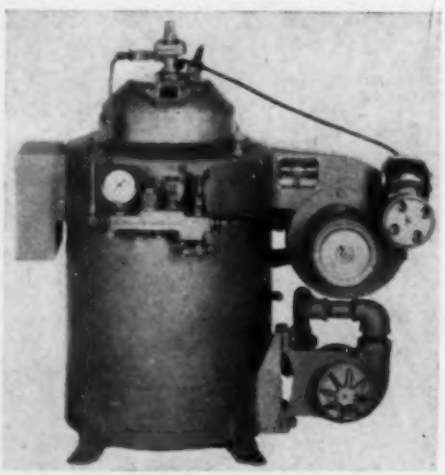
Thermostatic Steam Traps

No. 2765—Sarco Co., Inc., 475 Fifth Ave., New York 17, N. Y., has announced the successful manufacture of bellows from heavy wall bronze tubing, drawn and helically corrugated in their own plant by methods developed by them. This has made possible, according to an announcement last month, the introduction of an entirely new line of thermostatic steam traps for pressures up to 225 psi, using single, large diameter bellows, for inlet sizes ½ to 2 in., inclusive, and with capacities double those of the company's "No. 9" series.

The new traps are available in two pressure ranges, "No. 9-100" for pressures of 0 to 100 psi, and "No. 9-225" for pressures of 0 to 225 psi. The heavy wall bellows is screwed into the end closures and the joints are sealed by brazing, using electronic induction heating equipment.

Packaged Hot Water Heater

No. 2766—The new hot water heater illustrated has been developed by the Vapor Car Heating Co., Inc., 80 E. Jackson Blvd., Chicago, Ill., to meet wartime demands for a light weight, high capacity unit. Weighing less than 200 lb, it has an output of 150,000 Btu per hr with a generous reserve for emergency demands. Dimensions are 30⅞ in. high by 16 in. wide by 25 in. long.



It will operate on either diesel fuel or gasoline and can be supplied with an a-c or d-c electric motor or single cylinder gasoline engine. Standard automatic control or modulated control is provided to specifications. Ignition is continuous with bypass control of fuel.

The high efficiency coil handles water or glycol solutions to meet Army and Navy specifications at temperatures up to 300 F.

It is recommended by the maker as source of water supply or for heating systems in railroad cars or buildings. It is particularly adaptable as a mobile unit for furnishing hot water or heat through the means of a heat exchanger for heating lubricants or other solutions.

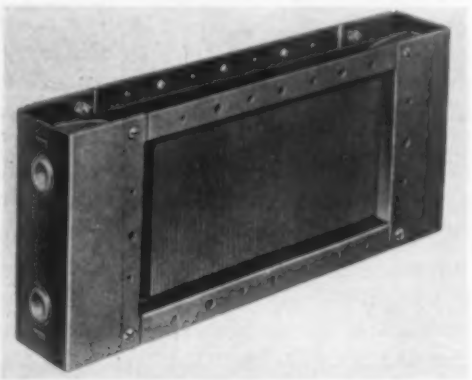
Self Sealing Couplings

No. 2767—A new sound and color film, Saving Hours for Victory, is now available for showings throughout the United States. This 16 mm talking film provides field and shop demonstrations of the quick-detachable features and replacement operations covering self sealing couplings and flexible hose lines and fittings which are standard equipment on a large part of American aircraft, and which open a new field of industrial application to air conditioning equipment, says the manufacturer.

Prints of the film are available to maintenance and service organizations. Running time is 10 min. Requests should be sent to Clarke H. Field, Aeroquip Corp., East St., Jackson, Mich.

Heating Coils

No. 2768—To meet the more specialized requirements of extended surface heating coils in modern air conditioning, heating, drying, and processing systems, the Modine Mfg. Co., 1772 Racine St., Racine, Wis., has introduced a new and broader line of copper blast heaters and booster units. They incorporate important design modifications which contribute to improved performance and durability, and which adapt these coils more closely to the actual needs of heating engineers and drying equipment designers, according to the manufacturer.



Available now for wartime priority applications, these coils, in the types and sizes cataloged, will also be furnished after the war and can be specified for postwar systems and equipment being designed today. The design features all-copper and copper alloy con-

Heating, Piping & Air Conditioning, [2-45]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

2765	2766	2767	2768	2769	2770	2771	2772	2773
2774								
4867	4868	4869	4870	4871	4872	4873	4874	4875
4876	4877	4878	4879	4880	4881	4882	4883	4884
4885	4886	4887	4888	4889	4890	4891	4892	

Name ..... Title .....

Company .....

Address .....

City ..... State .....

densers, scientifically die-formed fins which are permanently bonded to tubes by metal, pressure resisting brazed construction of steam carrying passages, and new provision for even steam distribution within the coils.

Casings are designed for duct installation in vertical or horizontal positions and permit use of ducts having cross-sectional areas no larger than the face of the coils. A new baffle arrangement helps direct flow of air through coil. Casing flanges are pierced to permit use of either bolts or self-tapping sheet metal screws. Parker-Bonderizing protects the casings from rust and insures paint adhesion.

New Three Inch Stroke Pump

No. 2769—A 3 in. stroke, 20 hp unit has recently been added to the line of "Aldrich-Groff" controllable capacity pumps. Originally introduced four years ago, the line now consists of 20 hp, 40 hp, 60 hp, and 100 hp units which cover a wide range of capacities at various pressures up to 15,000 psi.

Primarily used for boiler feeding, desuperheater feeding, pipe line, process charging and proportioning, these pumps are installed where accurate, automatic control of delivery is important. Operated at constant speed, from no-load to full rated capacity, power consumption of these pumps is practically proportional to discharge, says the manufacturer, the Aldrich Pump Co., 4 Pine St., Allentown, Pa.

Portable Heat to Meet Zero Weather Emergencies

No. 2770—The antidote for winter-locked trains, buses, and automobiles and for all manner of outdoor work hitherto prevented by subzero temperatures will be generally available to the public by the time another winter rolls around, says Surface Combustion, 2375 Dorr St., Toledo 1, Ohio, which has developed a portable heater used at Alaska air bases and for other military purposes. The need for safe preheating of airplane engines, cabins, instruments, and windshields in climates where 50 deg below zero is not uncommon was responsible for the development of the unit.

Frozen railroad switches, responsible for many train delays in the cold spell which greeted the New Year, could be quickly thawed with one of the portable heaters, the company points out. Owners of truck and bus fleets, it is expected, will acquire units both to preheat cold equipment before starting a run and for wheeling out on the road to free any equipment in service which becomes ice- or snow-bound. Garages could provide similar service for individual motorists.

The portable heater employs the "whirling flame"

AEROQUIP* ANNOUNCES:
REFRIGERATION SERVICE CHARGING LINE

3 PIECES (EACH REPLACEABLE) ASSEMBLY WITHOUT SPECIAL TOOLS. FITTINGS CAN BE REMOVED FROM HOSE AND REUSED REPEATEDLY.

TO FIT STANDARD ¼" S.A.E. FLARED TUBE CONNECTION IN STANDARD LENGTH 24" 36" OR LONGER

*AEROQUIP HOSE LINES AND FITTINGS ARE STANDARD EQUIPMENT ON ALL U.S. ARMY AND NAVY COMBAT AIRCRAFT

AEROQUIP CORPORATION
JACKSON, MICHIGAN, U.S.A.

The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 Hp. and smaller. Other sizes and types available up to 150 Hp.

Now, while the delivery situation in the entire motor industry is serious, the arrival of a new Howell Motor gives double satisfaction.

First, you get the satisfaction of receiving a better performing motor.

Second, you know that it will give you better service, because we have rigidly adhered to our policy of maintaining prewar standards and have steadfastly refused to compromise in quality.

Sure, we are swamped with orders today! But we fully recognize our obligations and are putting forth our maximum efforts to see that Howell Motors are distributed fairly among all of our customers.

Buy Horsepower by

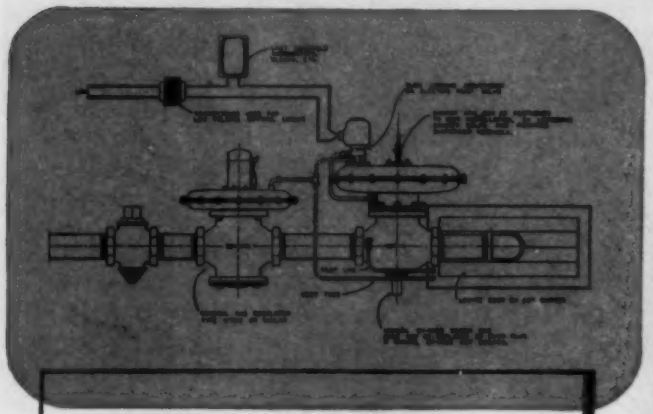
HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

Insist on these 5 FEATURES

For efficiency, safety and economy, specify the ONE valve that answers *all* your requirements for industrial and commercial burners and furnaces.



GENERAL CONTROLS
Type B-55
Slow Opening Gas Valve

Here, in one sturdily-constructed easily-installed valve, you get everyone of these necessary features.

1. Adjustable opening time—5 to 60 seconds.
2. Widest operating pressure range—handles up to 5 lbs.
3. Widest range of sizes—available from ¾" to 6" i.p.s. for manufactured, natural or L. P. gases.
4. Ample power for louvre control. Damper arm easily rotated to any desired position.
5. Low current consumption. In sizes up to 1½" i.p.s. 8 watts; 2" to 6"—14 watts.

The advanced design of this valve has made it the choice of industry. Simplicity of design makes this unit foolproof and trouble-free. Fast closing time is fixed, regardless of opening adjustment. The 3-way pilot valve is operated by the quiet General A.C. Solenoid. B-55's are fail-safe in the event of diaphragm rupture, current failure or binding damper mechanism.

For further information, contact your nearest General Controls factory branch or distributor, or write for Catalog 52-B.

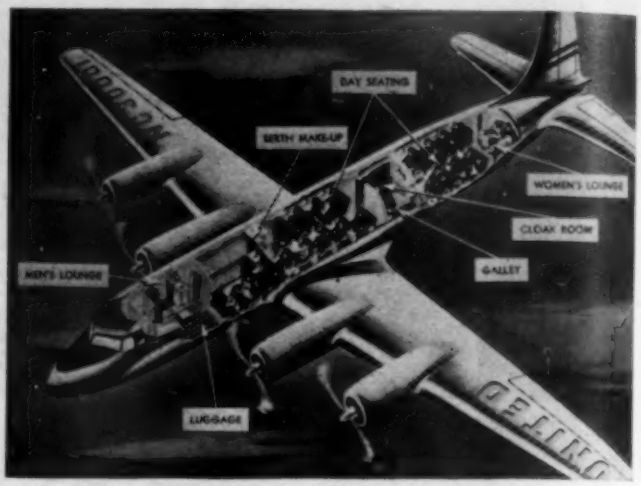
GENERAL CONTROLS
501 ALLEN AVENUE GLENDALE 1, CALIF.
BRANCHES: Atlanta, Cleveland, Philadelphia, Kansas City, Dallas, Boston, New York, Chicago, Detroit, Houston, Denver, San Francisco
Distributors in Principal Cities

principle, and burns gasoline, kerosene, or oil.

Military uses other than in aviation, the manufacturer said, are for warming hospital tents, headquarters tents, and barracks. In the hot, moist tropics, the armed forces are using the unit for drying out workshops, keeping plane instruments free of damage from moisture while on the ground, and for other drying purposes.

Postwar DC-6's To Be Air Conditioned

No. 2771—Airplane supercharging and pressurization, which supplied the answer to high altitude, long range aerial bombardment, will provide sky guests aboard tomorrow's luxury liners with living room comfort while flying at altitudes from 10,000 to possibly 25,000 ft, according to W. W. Davies, United Air Lines' research engineer.



United is investing $25,000,000 in a fleet of 50 four engined Douglas transports—35 DC-6's capable of whisking 50 passengers from California to New York in 8½ hr, and 15 DC-4's of 44 passenger capacity, both to be equipped with air conditioning, temperature control, and the latest wrinkles in sound proofing. The streamlined craft, inaugurating a new era in commercial air transport immediately after the war, are to be commercial developments of the Douglas C-54 military transport which has flown vital war supplies and "VIP" (very important people) to and from war theaters all over the world.

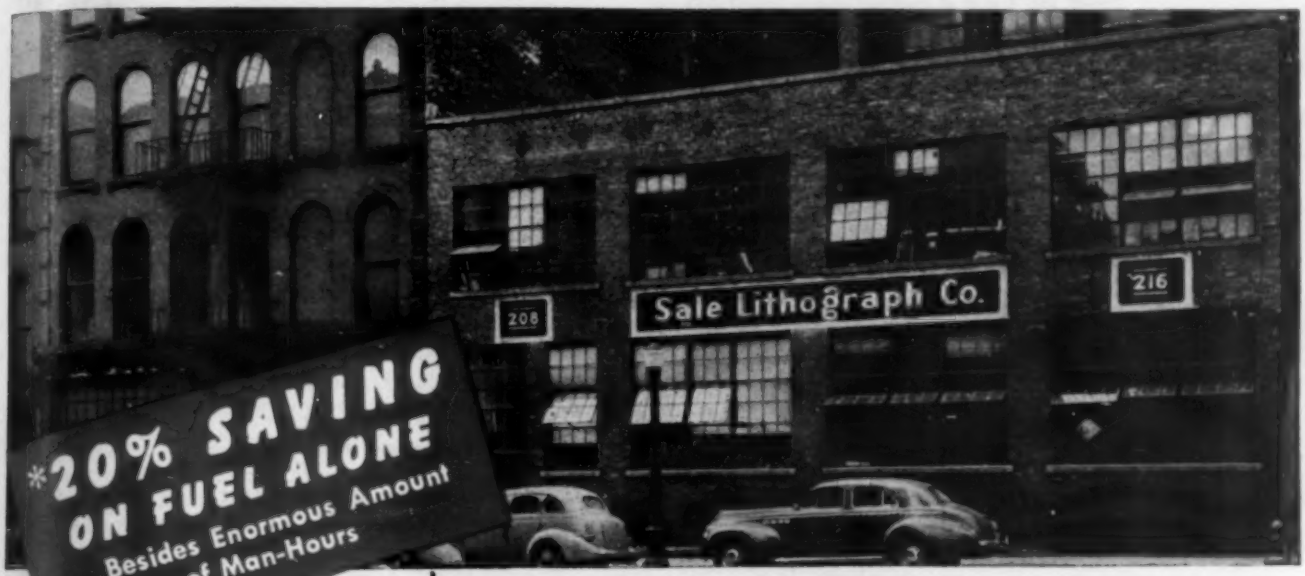
The cabins of the DC-6's, approximately 64 ft long, 10 ft wide, and over 7 ft high, will be pressurized to make possible an apparent altitude considerably lower than the actual altitude. For example, when the plane reaches 16,000 ft, interior pressure would be equal to Denver's mile-high air; at a 20,000 ft ceiling the interior pressure would be equivalent to 8000 ft.

Tentative specifications for the DC-6 provide for two superchargers, mounted on the inboard engines, to supply compressed air for pressurizing the cabin by means of ducts leading into the cabin and containing adjustable openings. Because the act of compressing air generates heat, it will be necessary on hot days to employ a means for cooling—or air conditioning—the cabin. This would insure passenger comfort even with outside temperature of 100 deg or more.

On cold days, or at higher altitudes where the heat

PAYS A PROFIT IN TIME AND MONEY

. . . A TYPICAL CASE OF WINKLER STOKER SAVINGS!



"...Previous to the time we installed this stoker, we had a considerable amount of lost time due to temperature reduction at night. It required several hours for us to bring up the heat in the morning, so that our press cylinders would be sufficiently warmed and the ink in our presses would flow satisfactorily.

"After the Winkler Stoker was installed, we were able, without additional labor, to maintain proper night temperature, so that full production could be resumed upon the arrival of our men in the morning.

* "After going through the past season, we have found that we are *saving 20% in fuel* as compared to hand firing, *besides the enormous amount of man hours* saved in our production by having this uniform temperature.

"Due to the satisfaction we received from this stoker, we have placed the order for a stoker to be installed in our other building."

THE SALE LITHOGRAPH CO.

Low-cost fuel, automatic control and minimum attendance time are the basic reasons for stoker economy. The *degree* of economy achieved, however, depends upon the efficiency of the stoker. In this respect the Winkler Stoker has made an enviable reputation.

The Winkler Burner, for instance, is an example of sound, creative stoker engineering, with design features which minimize segregation of coal sizes, assure proper distribution of air and in general improve combustion efficiency. Tuyere and dead plate construction is heat-dissipating, hence warp-proof and longer-lived.

Full protection without a shear pin!

For service-free, dependable operation, the Winkler Fully Automatic Transmission stands alone. The *extra power* developed by the *internal planetary gearing* of this design is ample to crush all ordinary obstructions in the coal. If the feed screw should become blocked by a metallic or uncrushable object, the Winkler Safety Release goes into action. *Automatically and continuously* it disengages and resets the transmission until the obstruction is removed. The Winkler then resumes normal operation without suffering the slightest damage.

SEE THIS DEMONSTRATION!

You need not leave your office to see the proof of Winkler mechanical superiority. Any Winkler Distributor will be glad to show you an interesting X-ray presentation of Winkler construction—an instructive exhibit to specifiers and installers of automatic coal burning equipment.

Winkler Stokers for homes, apartments, commercial and industrial buildings can now be installed without priority approval.

WINKLER

fully automatic STOKERS

U. S. MACHINE CORPORATION • LEBANON, INDIANA

Now Ready!

- NEW FEATURES OF DESIGN
- NEW PERFORMANCE ACHIEVEMENTS
- NEW SIZES AND CAPACITIES
- NEW APPLICATIONS

Catalog A-145, just off the press, covers an entire range of Centrifugal Pumps, especially engineered for industrial, municipal and other water supply systems. Cross-section illustrations, performance curves and structural details show at a glance why users of Economy Pumps save in cost, power, labor. Selection tables simplify the choice of exact types and sizes to handle specific requirements. A copy of the catalog is yours for the asking, on your letterhead. So are the services of our engineering staff—for special problems—without obligation.

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ECONOMY PUMPS, INC.
HAMILTON, OHIO • U. S. A.

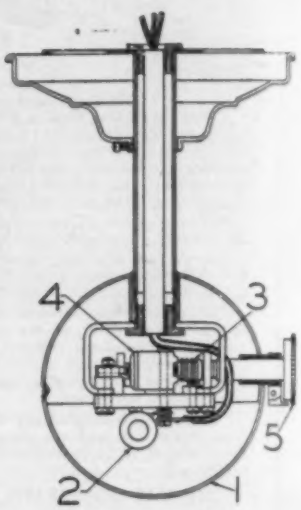
generated by the air compression is not sufficient to keep the cabin warm, it is planned to supply additional heat through internal combustion type heaters. These units, using gasoline as a fuel, are designed to maintain desirable inside temperatures when those outside range from 40 to 50 below zero. Studies of similar units for heat deicing of the DC-6 wing and tail surfaces are being made.

Cabin ventilation will be maintained at an average rate of 20 cfm per passenger, sufficient to completely change the air approximately every two minutes, according to present plans.

Insulation for heat and soundproofing is expected to be a glass fiber material similar to that employed by United in re-fitting as passenger-cargo planes the DC-3 transports recently returned by the Army. Desirable features include elimination of vibration, reduction of the cabin's sound level, and heat insulation.

Radiant Heat Thermostat

No. 2772—When the manufacturer's weather control "Type STA" is used to control a radiant heating system, a special room thermostat is needed to control the auxiliary bulb. To assure comfort conditions, the thermostat must be sensitive to both air temperature and radiant rays. The "Thermoray" shown here, announced by Sarcotherm Controls, Inc., 222 W. North Bank Drive, Chicago 54, Ill., is designed to meet these special requirements of radiant heating systems.



A hollow sphere *1*, about 4 in. in diameter, blackened over the outside surface for complete heat absorption, contains a small electric heater *2*. This heater is wired in parallel with a bulb heater and is proportioned to keep the outside surface of the sphere at 80 F. A thermostatic bellows *3* actuates a normally open switch *4*.

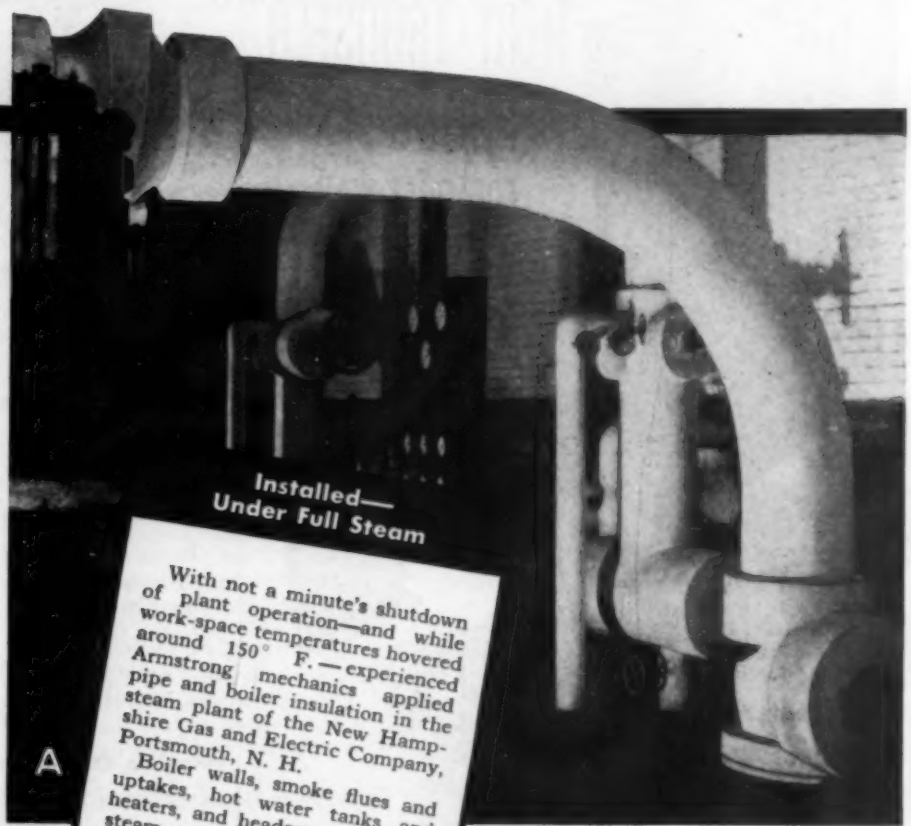
Eighty degrees corresponds to the normal surface temperature of the human body when comfortable. When the combined effect of the radiant rays from the heating panels and the air temperature in a key room increases so that less heat is given off by the sphere, the temperature inside it increases, thus closing switch *4*. This closes the circuit to the bulb heater, causing oil in the auxiliary bulb to expand, which in turn will close the hot water inlet to the main valve. The system water then simply recirculates without the addition of any hot water from the boiler, until the key room is brought back to normal temperature. Switch *4* then opens again and the outside bulb of the weather control takes over control of the heating system. The thermostat *3* can be manually adjusted over a total range of 30 F by turning the calibrated wheel *5*.

This instrument is available in two types, for ceiling or wall mounting.

You're sure of a dependable job with ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION

COMPLETE RESPONSIBILITY for the entire job rests on the shoulders of one large experienced organization when you use Armstrong's heat insulation contract service. This assures you of dependability in every detail of planning, supervision, materials, and workmanship. You enjoy the benefits of Armstrong's wide engineering background, materials of tested and proved efficiency, and experienced installation mechanics.

For complete details, write Armstrong Cork Co., Building Materials Division, 4402 Concord Street, Lancaster, Penna.



A

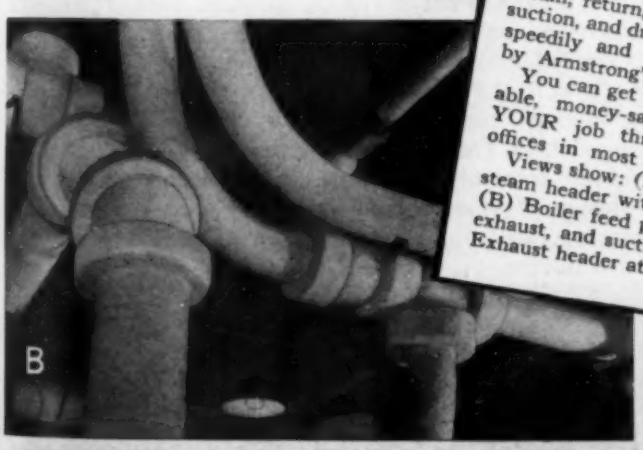
Installed— Under Full Steam

With not a minute's shutdown of plant operation—and while work-space temperatures hovered around 150° F.—experienced Armstrong mechanics applied pipe and boiler insulation in the steam plant of the New Hampshire Gas and Electric Company, Portsmouth, N. H.

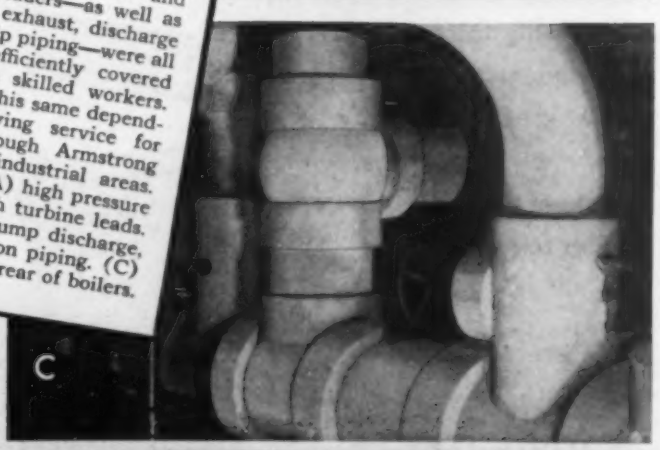
Boiler walls, smoke flues and uptakes, hot water tanks and heaters, and headers—as well as steam, return, exhaust, discharge suction, and drip piping—were all speedily and efficiently covered by Armstrong's skilled workers.

You can get this same dependable, money-saving service for YOUR job through Armstrong offices in most industrial areas.

Views show: (A) high pressure steam header with turbine leads. (B) Boiler feed pump discharge, exhaust, and suction piping. (C) Exhaust header at rear of boilers.



B



C

ARMSTRONG CORK COMPANY

Complete Insulation (A) Contract Service for All Temperatures, from 300° below zero to 2600°F.

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Dependable

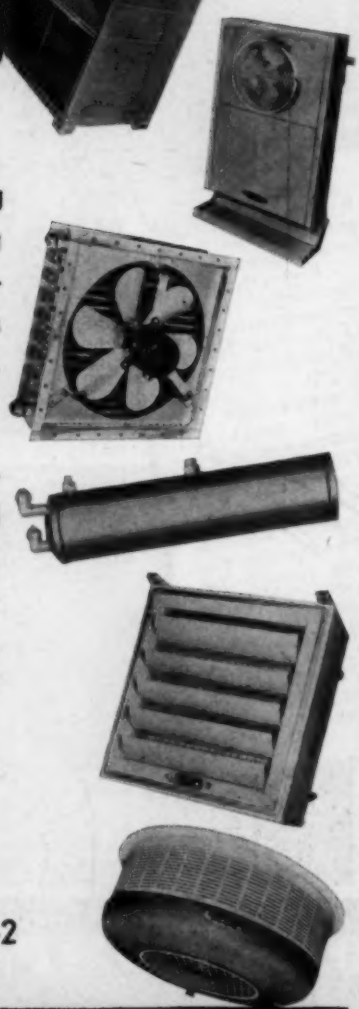
HEAT TRANSFER PRODUCTS FOR POST-WAR RECONVERSION

AMERICA'S rising standard of living will make increasingly greater demands upon the art of refrigeration.

Inevitably the refrigeration industry will seek creative ideas and new structures in heat transfer in order to satisfy those demands.

We are ready.

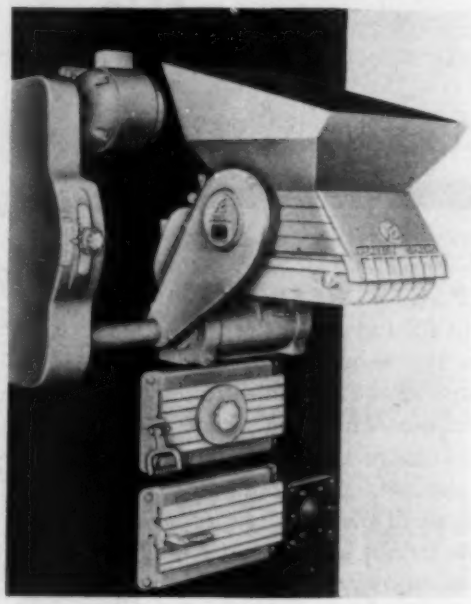
WRITE FOR CATALOG R142



KRAMER TRENTON CO.
TRENTON, S. N. J.

Spreader Type Stoker

No. 2773—A new spreader type stoker has been announced by the American Engineering Co., Aramingo Ave. and Cumberland St., Philadelphia 25, Pa. "Streamlined with a purpose," this automatic stoker efficiently burns all kinds and grades of solid fuels, including by-products and plant refuse, whether wet or dry, says the manufacturer.



It can be installed under most existing boilers to produce steam from 175 hp up to 200,000 lb per hr.

Advantages that cut fuel bills and boost boiler room operating efficiency include: fully protected mechanism, accessible without tools; simple controls; water cooling; and long-life grates with power dump.

Heating Coils Melt Snow

No. 2774—"Radiant heating" is now being brought out-of-doors to put an end to shoveling snow or chopping ice from walks and driveways, the A. M. Byers Co., Clark Bldg., Pittsburgh 22, Pa., points out.

In at least two cities in the east such outdoor installations have been made at factory buildings, one at the Bethlehem, Pa., works of the Sarco Mfg. Co., the other at the plant of the Hewitt Rubber Co., Buffalo, N. Y. Designers of some postwar filling stations also have incorporated similar schemes in driveways leading to gas pumps.

Because employees at the Sarco works had to walk out-of-doors a considerable distance from the main plant to the cafeteria and it was not feasible to erect a covered walkway, a concrete footpath was installed, with wrought iron heating coils beneath. A snow- and ice-free walk resulted. Hot water is circulated through the 1¼ in. pipes for melting the snow which falls on the footpath, or to prevent the formation of ice during a freezing rainstorm.

In the Hewitt installation, low pressure steam from the plant's boiler is fed into similar size wrought iron pipe coils whenever it is necessary to melt and remove snow from the loading strip in the plant's yard, before the fall has had a chance to pile up. The installation is 80 ft long and 8 ft wide.

Strength-Ductility

...AND ITS OVERALL IMPORTANCE IN AN ENGINEERING METAL

In general terms, ductility is the property of a metal that permits it to be deformed without fracture.

It is the exact opposite of brittleness.

If two materials have the same strength and hardness, the one with greater ductility has a good chance of holding up under overloads which would snap the other.

Thus, ductility is especially important in bolts, where strain is likely to result from too vigorous tightening or from abrupt temperature changes. It also is an essential property in metal gaskets. A strong, ductile gasket will adapt itself readily to imperfections in joint surfaces while maintaining the strength necessary to prevent leakage.

And, finally, high ductility is a great advantage in fabrication. The more ductile the material, the more easily it can be handled by the usual cold-working methods... bending, deep drawing, spinning, cold heading.

Strength and Ductility

By the very nature of materials, strength and ductility are divergent properties. As one increases the other decreases. As a general rule, highly ductile metals are soft and weak; some high strength metals are hard and comparatively brittle. But one of the outstanding characteristics of INCO Nickel Alloys is their exceptional combination of strength with high ductility.

How Ductility is measured

There are several methods for testing the ductility of metals, but the most common method is to pull a specimen of the metal on a tensile testing machine until it breaks. The ductility of the metal is then determined by measuring how much the specimen "stretched" or elongated.

This is the method which was used in measuring the strength-ductility of Monel and other metals as shown in the charts below.

What the charts show

In Fig. 1, showing tests made by R. L. Templin and R. G. Sturm, the top point of the curve indicates the tensile strength of the various metals. Ductility... as evidenced by the metal's "stretch"... is shown by the horizontal carry of the curve to the point where it drops off sharply.

Fig. 2 shows the results of strength-ductility tests with ⅜" diameter bolts of Monel, brass, bronze and steel, as determined at Columbia University, New York City. This test shows the high value of Monel for bolts and similar applications.

Spun Monel diaphragms

Stronger than mild steel, Monel is ductile enough to be formed in the most severe of all metal working methods... spinning.

Diaphragms for gas meters and gas analysis instruments are spun from Monel, as illustrated in the accompanying photo.

Ductility makes the spinning process easier... the combined strength, hardness and corrosion resistance mean longer life for the finished Monel part.

HIGH-TEMPERATURE HIGH-PRESSURE STEAM *line gaskets formed from Monel by Goetze Gasket & Packing Co. Combined strength-ductility of Monel permits thinner gaskets, saving stress on bolts. Monel gaskets adapt self to joint surfaces... assure strong, tight, lasting seal.*

SPINNING MONEL DIAPHRAGMS *for gas meters and gas analysis instruments at Schwab Specialties Company, Pittsburgh, Pa. Strong, ductile, corrosion-resistant Monel is readily fabricated... assures long life in severe service.*

Gaskets for high temperatures

Typical Monel gaskets for lines carrying steam at high pressures and at temperatures over 500° F. are illustrated also. Since Monel is stronger at 1000° F. than mild steel is at room temperature, thinner and narrower gaskets can be used. Thus, stresses on flange bolts can be reduced considerably. Yet, despite its strength, Monel is so ductile that a gasket shapes itself to slight imperfections in the flange faces as the bolts are tightened, forming a sealed joint that stays tight at high pressures. Alternate heating and cooling do not embrittle Monel gaskets... ductility remains at a high level.

• • •

For further information about ductility and other properties of metals, write for the booklet, "The Technical Editor Speaks." A copy is yours for the asking. Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall St., New York 5, N.Y.

TENSILE STRENGTH-DUCTILITY CURVES
FOR SOME METALS AND ALLOYS

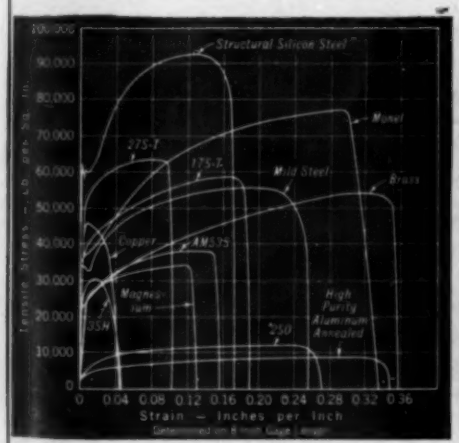


FIG. 1

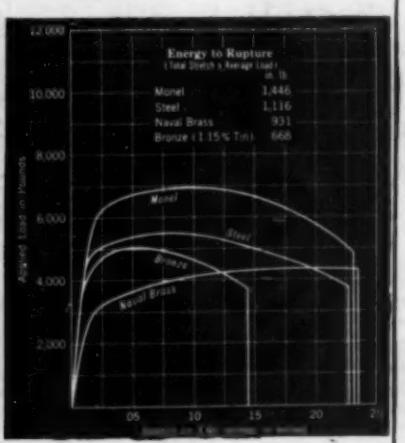


FIG. 2

CHECK PIPING TO AVOID FUEL WASTE

A heating trouble far more common than generally realized is caused by low spots in the steam supply lines to radiators.

A recent case which came to attention illustrates the point. In a large apartment building one wing would not heat unless the steam pressure in the boiler was raised to 7 or 8 psi. Then the other wing became too hot, windows were opened, heat lost, and everybody was uncomfortable.

Investigation showed that in order to avoid some obstruction the steam supply line was dropped down 4 or 5 ft for a short distance and then up again. This made a perfect seal so that no steam could pass unless the pressure was enough to push the water out of the low spot. While this may seem like an extreme case it actually occurred and rearrangement of the piping corrected the trouble. Exactly the same thing occurs in many radiators.

Probably every operating engineer has complaints that this or that radiator won't get hot. Let him carefully check the piping to see if there is any low spot that would hold water and then remove it if found. The manager would do well to have a survey made by a competent steamfitter.

And when he is doing this, let him see that the air vents on the radiators are in working order. An airbound radiator is no radiator at all. Save fuel by making every part of the heating plant do its duty.—*From a letter by Joseph Harrington, advisory engineer, Northern Illinois Coal Corp., distributed to promote the objectives of the National Fuel Efficiency Program.*

75 BED HOSPITAL CONDITIONS OPERATING ROOMS

The installation of air conditioning in the operating rooms of the Waynesboro, Pa., hospital puts that town in the forefront of those of comparable size which enjoy this advantage, says Terry Mitchell, of the Frick Co.

The hospital contains 75 beds. It has two operating rooms, the larger of which measures 16½x19½x10½ ft high; the other is 15½x12x10½ ft. Adjoining these rooms are the usual sterilizing and preparation rooms, with closets for the clothes used by the staff, etc.

The conditioned air is introduced directly into the operating rooms through two high velocity air diffusers located in the ceilings above one corner of each operating table; the air is exhausted through the loose doors between these rooms and the lobby, from which it passes into the sterlizing room and from there through a grille to the roof. The door from the hallway into the lobby is "tight," and so is the one from the sterilizing room into the operating room. The windows in the conditioned space remain closed at all times. Sufficient conditioned air is introduced to give eight air changes per hour in each room; none of the air is recirculated.

Independent and simultaneous control of temperature and humidity are provided, using pneumatic modulating devices. These control stations, being in the major operating room, enable the staff to adjust air conditions quickly: they are free from electric contacts which might cause a spark. The system

An AIRTHERM Direct Fired Unit Heater Will Reduce Your Heating Costs . . .

Airtherm Direct Fired Unit Heaters are designed for *efficient, controlled* heat which reflects a saving in your fuel costs. They can be installed in just a few hours without costly duct work, radiators, or pipes. They can be operated only when heat is needed without danger of freezing pipes, thus eliminating costly stand-by operation.

Airtherm Direct Fired Unit Heaters are built in standard sizes, with capacities from 300,000 to 1,500,000 BTU's.

Let us show you how we can reduce your heating costs. Send us your specifications or write for complete bulletin today.

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Fast, easy pipe cuts with this 4-wheel RIDGID

Regular RIDGID *Cutter has fast cutting thin-blade wheels.*

Cuts cleanly with a quarter turn

● In tight places it's a wonder. Short handle — and 4-wheels mean swift clean easy cuts, which you'll enjoy also where there's plenty of room to work. A beautifully balanced husky cutter that doesn't fool around, the stout frame making the special heat-treated steel wheels always cut true. Two sizes: No.42, ½" to 2"; No.44, 2½" to 4". Buy it for better cutting and long service — at your Supply House.

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WORK-SAVER PIPE TOOLS

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DOMESTIC "CONVERSION" BURNERS
1 to 6 gal. per hour

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general application type
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COMBINATION BURNER-GENERATOR UNITS
both steel and C. I. sectional boilers; forced warm air units; and instantaneous water heaters.

INDUSTRIAL OIL BURNERS
Manual - Semi Auto - and Automatic* for either un-heated or pre-heated industrial oils, up to 145 g.p.h. Built-in motor or belt drive.

****When pre-heated oils are burned the Petro Thermal Viscosity system insures consistent maximum combustion efficiency at all firing stages, automatically and reliably.***

Petro Engineering co-operation is still available. Research-development is active. When your post-war activities start, Petro will be ready for you.

OIL IS AMMUNITION USE IT WISELY

Full data on Petro Industrial Burners are in our Catalog—see Sweet's or Domestic Engineering Catalog Files — or we will gladly send copies on request.

PETROLEUM HEAT AND POWER COMPANY

Makers of Good Oil Burning Equipment Since 1903

STAMFORD CONNECTICUT

provides year 'round air conditioning. When the temperature outside is 90 F dry bulb, it will be 78 F inside, with a relative humidity of 55 per cent. Hot water is used for reheating in summer, when necessary, while steam provides heat in winter. A water spray adds moisture to the air stream in cold weather. The air all passes through a 20 in. x 25 in. x 2 in. filter, so placed that it can be easily cleaned.

The air conditioning unit is in a small closet space on the floor above the operating rooms. The 5 hp low pressure refrigerating unit stands close by; mounted above the unit is an all-copper heat exchanger and a balance loader which prevents undue short cycling of the unit during moderate weather. High and low pressure cutouts, pressure gages, isolation pads, and insulated suction and air supply lines are features of the installation. The controls further include a solenoid liquid valve, a back pressure control valve, two thermostats, humidistat, preheat and reheat valves with pneumatic motors, dampers, relays, switches, etc. The electro-pneumatic temperature and humidity control system includes a miniature air compressor and receiver.

In winter the system makes use of the steam radiators already installed, which are left operating, as a rule, to their full extent.

REPORTS '43 AND '44 CONSTRUCTION FIGURES

Construction volume in the 37 states east of the Rocky Mountains amounted to $1,994,016,000 during the year 1944, as compared with $3,273,990,000 during 1943, F. W. Dodge Corp. reported last month.

The decline in volume last year was attributable almost entirely to decreases in publicly owned construction, the statement declared. Total privately owned construction in 1943 amounted to $578,882,000 as compared with $558,924,000 last year, the figures show. Privately owned construction, as differentiated from publicly owned construction, last year accounted for 28 per cent of the total as compared with 18 per cent in the year immediately preceding.

Nonresidential building, represented principally by manufacturing buildings, accounted for $899,434,000 of the 1944 volume compared to $1,424,260,000 reported for this classification of construction in 1943.

Residential construction declined from $867,815,000 in 1943 to $348,443,000 in 1944. Private residential construction in 1944 accounted for 67 per cent of the total as compared with 47 per cent of the total for the year previous.

MINERAL WOOL ASSOCIATION ELECTS

Edward I. Williams assumed his new duties as president of the National Mineral Wool Association last month. Mr. Williams, long identified with the mineral wool industry, is president of the Riverton Lime & Stone Co.

Other officers and directors of the association are: M. G. Jensen, vice-president, Owens-Corning Fiberglas Corp.; W. H. Hill, treasurer, Baldwin-Hill Co.; T. C. Carter, director, Eagle-Picher Sales Co.; and L. M. Cassidy, director, Johns-Manville Sales Corp.

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Clean

Remove dirt, oil and water particles from the steam with *ADSCO Separators.* Made of semi-steel and fabricated steel, for low or high pressure lines, horizontal, vertical or special types.

Protect your meters, traps and other fixtures from sand, scale and other foreign matter with *ADSCO Strainers.* When in the market for T or Y Type Strainers and Macomb or special type strainers for low or high pressure service, send details of your strainer problem to ADSCO for recommendations and prices.

Other ADSCO Products include Expansion Joints for pipe lines, Condensation and Flow Meters, Tile Conduit for underground lines, etc.

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MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 65 YEARS.

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THIS is no time to start pulling up the old easy chair . . . not when we all know that only combined effort and all-out cooperation will speed the knock-out punch. Your iron and steel products are vital to the war effort . . . and they'll do a better job if you assure long-lasting protection by the PENNizing process of Quality Hot Dip Galvanizing . . . PENNizing, the lasting protection against corrosion.

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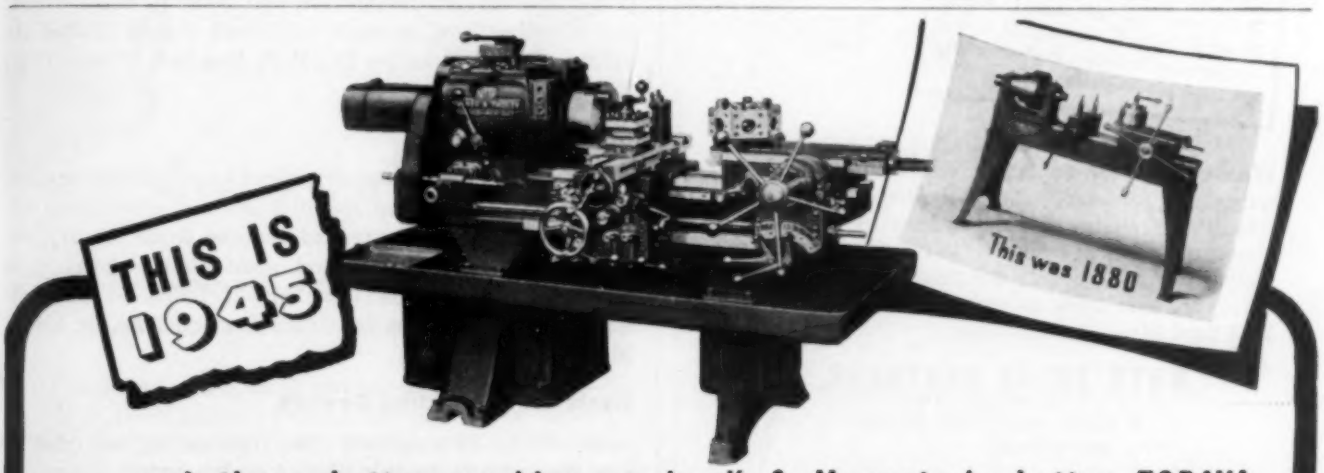

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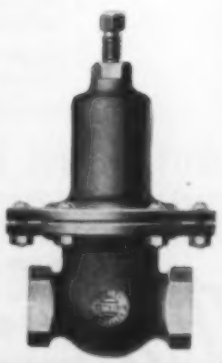
Built into every K & M Control is *experience plus* . . . not merely our own 66 rich years of pioneering and progress . . . but all the benefits of the know-how of other seasoned old-timers. For instance, Warner & Swasey. We've used their turret lathes since 1880, starting with the plain little fellow up above. Our new plant uses big babies that tool to a ten-thousandth. Dependable as they've always been, K & M Controls are better than ever today! Pictured is the compact K & M type 590 Diaphragm Relief Valve for pressures from 5 to 100 lbs., with a wide range of adjustability above or below pressures desired. Sizes ⅜" to 2"—angle or globe—set screw, hand wheel or test lever adjustment—with discs and diaphragms suitable for steam, water, air, oil or gas service.



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● For close coil regulation and steady, dependable performance, use this "A-P" Model 206 Thermostatic Expansion Valve. Factory-set at your desired superheat setting, no field adjustments are required, and the valve remains tamper-proof. Built under rigid factory inspection — with all parts microscopically examined and thoroughly tested during and after fabrication. Install Model 206 with full confidence in any application where the superheat setting has been predetermined.

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Wherever a non-adjustable expansion valve is required, or preferred, the A-P Model 206 is best. Absolutely reliable and dependable, it maintains a constant superheat over a wide range of evaporator temperatures — a real advantage in this type of valve. Its maximum capacity — 0.61 tons Freon; 1.32 tons Methyl or Sulphur.

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RECENT TRADE LITERATURE

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Blind Riveting

No. 4867—12 p. bulletin (A-4562) on high speed blind riveting with explosive rivets, which are similar in size and shape to ordinary solid rivets. Each has a small cavity in the shank with a tiny explosive charge in it which, when heated, expands the shank and sets the rivet.—E. I. du Pont de Nemours & Co., Inc., Explosives Department, Wilmington, Del.

Boilers and Radiators

No. 4868—32 p. booklet entitled Through Half a Century, marking the 50th anniversary of the National Radiator Co., and discussing the birth of the industry, founding and growth of the company, introduction of the "Aero" radiator, development of boilers, showing net sales of the company, etc.—National Radiator Co., 221 Central Ave., Johnstown, Pa.

Boiler Walls

No. 4869—4 p. bulletin on controlled expansion for protection against infiltration and leaks in boiler walls, and showing how a crack in a wall makes it lose its value.—Geo. P. Reintjes Co., P. O. Box 856, Kansas City, Mo.

Cooling Towers

No. 4870—12 p. catalog (440-A) on cooling towers, giving a list of typical installations and discussing the features of forced draft and induced draft towers, atmospheric deck towers, and atmospheric spray type towers. Construction data are included.—Lilie-Hoffmann Cooling Towers, Inc., 4239 Duncan Ave., St. Louis, Mo.

Electrical Connecting Devices

No. 4871—32 p. catalog (14) illustrating and describing the manufacturer's line of multi-contact plugs and sockets, terminal strips, fuse mounts, etc.—Howard B. Jones Co., 2460 W. George St., Chicago 18, Ill.

Electric Welded Tubing

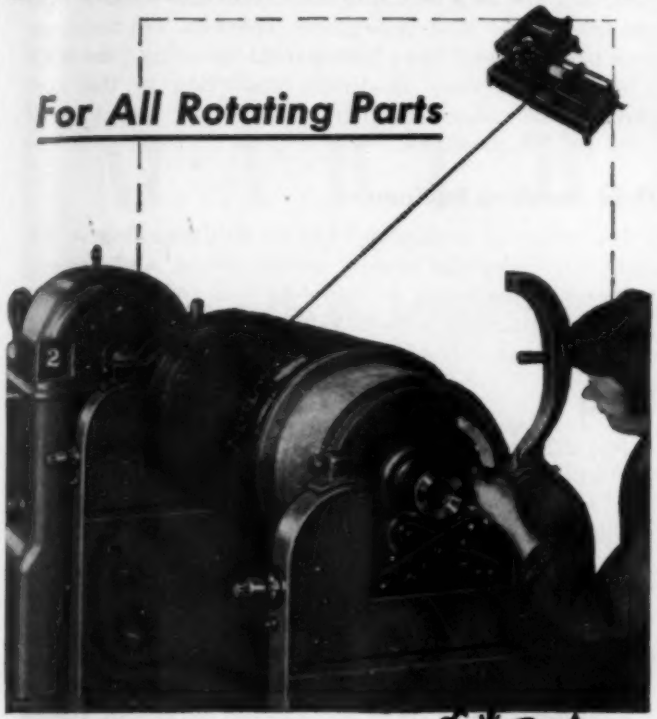
No. 4872—32 p. booklet for production designers containing specifications for various tubing applications and showing how "better products are obtained through the correct fabrication and application" of tubing. Numerous illustrations of wartime and peacetime products are given.—Formed Steel Tube Institute, Keith Bldg., Cleveland 15, Ohio.

Electronics

No. 4873—40 p. booklet (GEA-4309) in which is reprinted a series of articles by G. M. Chute on the fundamentals of industrial electronics. It comprises a handy

EASIER - SIMPLER - LOWER COST BEAR DY-NAMIC BALANCING

For All Rotating Parts



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DY-NAMIC BALANCE for all rotating parts will be a Post-War MUST! But it's no longer a tedious, difficult task to "drive out the WOBBLIES". Bear Dy-Namic Balancers do the job easier, faster and at lower cost. Available in many models and sizes, Bear Balancing Machines dy-namically balance *any* rotating part . . . fans, blowers, motors, armatures . . . even railroad car wheels . . . from 4 oz. up to 4000 lbs.! Used by hundreds of leading manufacturers in over 20 industries. Bear lower-priced, easy-to-operate Balancers solve your vibration problems FAST!

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At right: "VULCAN SUPERIOR", with reversible jaws and adjusting handle on top. 2 sizes for pipe 1/8 to 4-1/2 inches.

"Vulcan", the original chain pipe vise, is made entirely of tough, wrought steel ... no cast parts whatever. The dropforged jaws are of saw-tempered steel for file sharpening ... chains are of the same high quality as Williams' "Vulcan" Tongs. Fully guaranteed, and sold by Industrial, Plumbing and Oil Field Distributors everywhere.

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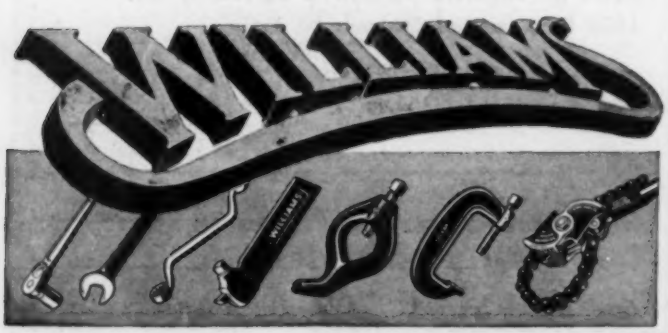

reference on the subject and includes numerous diagrams, graphs, and photographs.—General Electric Co., 1 River Rd., Schenectady 5, N. Y.

Flow Rate Indicator and Alarm

No. 4874—8 p. catalog (92-C) on the "Rotasight" flow indicator and alarm for indicating the true flow rate, and also as a flow rate alarm operated by flow rate changes only. The instrument operates on the area type principle and has a transparent metering tube with a float which rises in direct proportion to the flow through the meter.—Fischer & Porter Co., 7344 County Line Rd., Hatboro, Pa.

Fluid Handling Equipment

No. 4875—12 p. catalog (45) on fluid handling equipment for industrial plants, power plants, and process industries, featuring a complete line of suction and pressure strainers, remote valve control assemblies, interceptors, etc.—J. A. Zurn Mfg. Co., Erie, Pa.

Fluxes

No. 4876—2 p. data sheet on "Kwikflux" hard soldering flux for use "with all types of brazing, soldering, and welding apparatus."—Special Chemicals Co., 30 Irving Place, New York 3, N. Y.

Gas Burners and Gas-Oil Burners

No. 4877—4 p. bulletin (902) on gas burners and combined gas and oil burners with mechanical atomizing or steam atomizing oil units. The mechanical and operating features of these burners for natural or forced draft operation are described and illustrated.—Peabody Engineering Corp., 580 Fifth Ave., New York 19, N. Y.

Insulation

No. 4878—Poster for plant use suggesting insulation of piping and equipment to save fuel, published in cooperation with the National Fuel Efficiency Program. Figures on fuel savings to be made by insulation of boilers, pipe, and flanged joints are presented.—Industrial Mineral Wool Institute, 441 Lexington Ave., New York, N. Y.

Leather Belting

No. 4879—56 p. leather belting selection and application manual, providing a simple nontechnical approach to the subject and with complete data on selection, as well as suggestions on installation, operation, etc., of drives. There is a brief catalog section of belting and accessories.—Graton & Knight Co., 356 Franklin St., Worcester 4, Mass.

Lubrication of Air Tools

No. 4880—16 p. issue of Lubrication (Vol. 30, No. 11) devoted to the lubrication of portable air tools, describing how such tools work, their lubrication requirements, the nature of the lubricant best suited to air tool protection, cleaning procedure, etc.—Texas Co., 135 E. 42nd St., New York 17, N. Y.

Moisture Detectors

No. 4881—Leaflet describing new "Delmhorst" moisture detector for lumber and wood products, and various

MARCH

month of the Red Cross drive

You've heard the stories of the Red Cross . . . the work of this great organization for our prisoners of war alone is worth your whole-hearted support . . . but the Red Cross is everywhere, working unceasingly for all of our fighting men and women and for their families.

March will be the month of the new Red Cross drive to raise funds for continuing Red Cross activity. This is *your* organization, *your* expression of gratitude to fighters. Make next month the biggest in Red Cross history . . .

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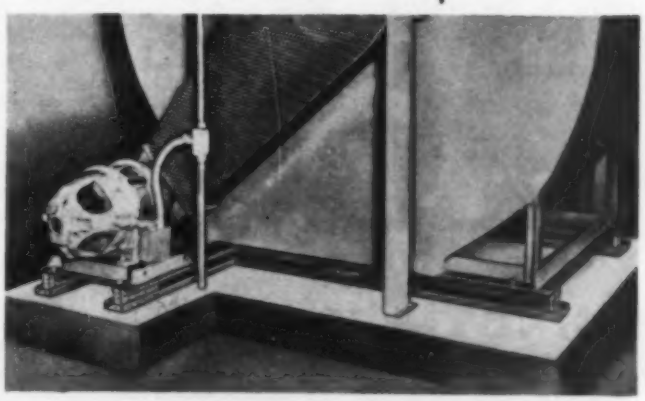

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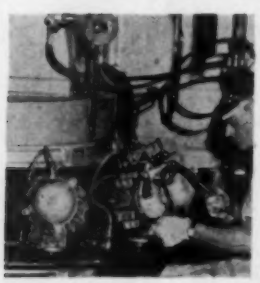
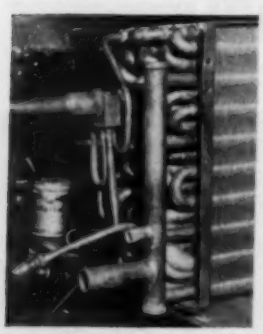
Since the outbreak of the war, I dusted off my Chief's ticket and went back to salt water again. I have used considerable Sil-Fos and Easy-Flo, chiefly in refrigeration work. Due to the experience I had in shore-side work, I wouldn't think of going to sea without a "B" tank, a jar of Handy Flux and a supply of Sil-Fos and Easy-Flo. If more marine engineers were shown how practical and helpful these alloys can be, a lot of time and expense could be saved them and the ship operators.



Typical of the work done with SIL-FOS and EASY-FLO in the fields mentioned are these two jobs—Above: Brazing copper tubing to housing of a domestic refrigerator compressor. Below: Industrial cooling unit completely fabricated with SIL-FOS.



Of course, hundreds of engineers in the marine, refrigeration and heating and air conditioning fields, DO know the value of these low-temperature silver brazing alloys and are just as strong for them.

They, likewise, know from experience that these two low-temperature silver brazing alloys, originated by Handy & Harman, make remarkably strong, leakproof, corrosion-resistant joints with exceptional speed, reliability and economy. That's why tons of SIL-FOS and EASY-FLO are used right along throughout these fields on a wide diversity of ferrous, non-ferrous and dissimilar metal joining work, including maintenance and repairs.

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If you are not familiar with these alloys and what they can do, now is the time to investigate and to start reaping the benefit of their production-boosting, cost-cutting advantages in your present and future metal joining operations. For full details, write today for your copy of **BULLETIN 12-A.**

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construction materials, which (according to the manufacturer) gives instant readings from 7 to 25 per cent, and is accurate within 1 per cent.—Colloid Equipment Co., Inc., 50 Church St., New York, N. Y.

Oil Burners

No. 4882—4 p. bulletin (802) on mechanical atomizing and steam atomizing oil burners, describing and illustrating the mechanical and operating features, for natural or forced draft operation.—Peabody Engineering Corp., 580 Fifth Ave., New York 19, N. Y.

Plastic Coating

No. 4883—Folder describing properties, uses, and advantages of a general purpose, cold applied, protective plastic coating known as "Amercoat No. 33." A list of corrosive agents to which this product is impervious is featured.—Amercoat Division, American Pipe and Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif.

Power Plant Equipment

No. 4884—24 p. catalog (449) on equipment for power plants, including check valves, pump governors, traps, high and low alarm water columns, gages, gage cocks, feedwater regulators, pump valves, etc. Each product is illustrated, diagrammed, and described.—Williams Gauge Co., 1620 Pennsylvania Ave., N. S., Pittsburgh 12, Pa.

Publications

No. 4885—16 p. 1945 catalog of ASME publications, including books on special subjects, American standards adopted and published by the ASME, the boiler construction code, power test codes, bibliographies, biographies, etc.—American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Refrigeration Service

No. 4886—4 p. bulletin, addressed to ice manufacturers, suggesting many new services which can be offered to the public—such as locker service, quick freezing, food processing, freezer storage, etc.—Frick Co., Waynesboro, Pa.

Rotary Pumps

No. 4887—6 p. bulletin (306) presenting facts about rotary pumps, featuring a diagram illustrating the swinging vane principle, as well as an illustration explaining graphically the operation of relief valves.—Blackmer Pump Co., 1920A Century Ave., S. W., Grand Rapids 9, Mich.

Steam Generators

No. 4888—6 p. bulletin describing and illustrating the "Type LFS International LaMont" steam generators, showing how prefabrication and shop tested subassemblies reduce boiler erection time.—International Boiler Works Co., East Stroudsburg, Pa.

Steam Heating Appliances

No. 4889—86 p. loose-leaf bulletin (634) on low pressure steam heating appliances, with sections on differential heating, traps and strainers, valve and pipe sizing

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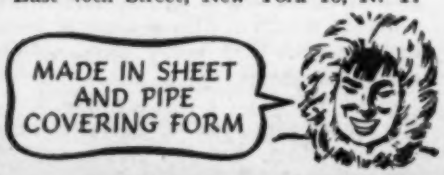

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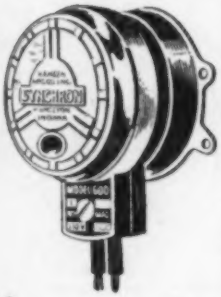

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STANDARD SYNCHRON MOTORS are compactly built, with rotor and coil nested in a sturdy case 2 3/4" x 1 5/16"—with power to pull 8 oz. direct load continuously at 1 RPM. They are built for speeds of 1 to 300 RPM, clockwise, or counter-clockwise, in all voltages and cycles.

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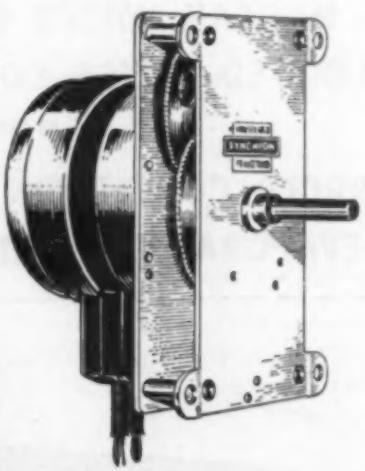

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tables, pumps, unit heaters and convectors, and pressure reducing valves. In addition, there is included a 26 page engineering data section with much pertinent information, including design data, conversion factors, etc.—C. A. Dunham Co., 450 E. Ohio St., Chicago 11, Ill.

V Belt Drives

No. 4890—12 p. catalog (B6051E) presenting "all of the required information to make correct drive selections reduced to handy charts, tables and drawings." Newest product covered in this "Texrope" drive engineering summary is the manufacturer's "Magic-Grip" sheave, designed for fast easy mounting and dismounting. Another section covers the "Econograph" method of drive selection.—Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

V Belt Drives

No. 4891—16 p. booklet giving 19 reasons why the v belt drive "is the dominant drive of industry," giving a primer-like presentation of the basic advantages of multiple v belt drives.—Multiple V-Belt Drive Association, 140 S. Dearborn St., Chicago 3, Ill.

Water Deaeration

No. 4892—4 p. reprint (36) comprising an article by C. E. Joos entitled Water Deaeration Halts Corrosion of Equipment, discussing the need of cold water deaerators and the general design of equipment.—Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa.

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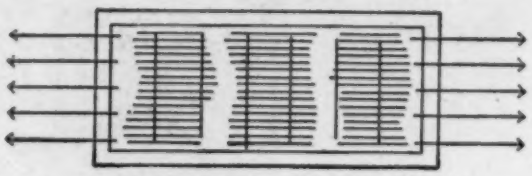
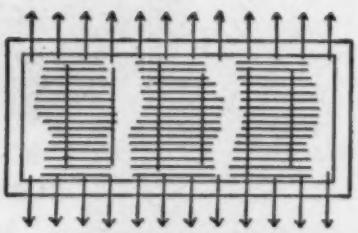
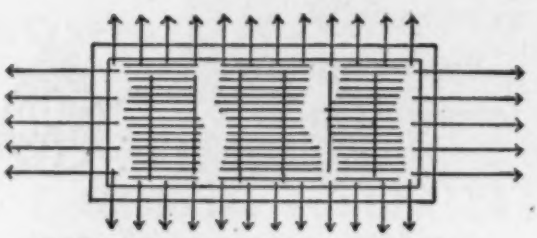


HORIZONTAL AIR FLOW



VERTICAL AIR FLOW



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Bituminous Coal

Acting to conserve limited supplies of certain bituminous coals, Solid Fuels Administrator Harold L. Ickes last month called on operators of large buildings in the eastern half of the United States, where coal is short, to reduce temperatures to 70 deg or lower at once. [James F. Byrnes, director of war mobilization and reconversion, called last month for a maximum of 68 deg in coal heated homes and buildings.]

Simultaneously, he announced an SFAW order prohibiting retail deliveries of certain sizes of scarce eastern-mined coals to large consumers with over 15 days' supply on hand. He urged users to take all precautions possible for saving fuel.

The action, he said, was taken because of limited supplies of certain bituminous coals used for heating large buildings in many localities throughout the eastern half of the United States.

Coals used for heating homes and small buildings are not affected by the order, he said. The limitation applies to deliveries of slack, nut-and-slack mixtures, mine run, pea, nut or stoker sizes of bituminous coal produced in Districts 1, 2, 3, 7 and 8 to consumers who use 25 tons or more of solid fuel per year. The mines in these districts are located in Pennsylvania, Northern and Southern West Virginia, Virginia, Eastern Kentucky and part of Tennessee.

"If consumers of these coals do not act immediately to reduce consumption, and particularly to end flagrant, widespread overheating, it may become necessary to institute more rigid controls which will compel fuel savings," Administrator Ickes said. "SFAW field men are expected to make spot checks and report instances where the delivery limitation is disobeyed, and where consumers do not cooperate by saving fuel.

"Many of the coals affected by this order are of the type critically needed for steel production and other essential war uses. Supplies of these particular coals are extremely short, and certain war plants are operating on a hand-to-mouth basis for fuel. Others are being forced to dip heavily into their reserve stockpiles in order to free shipments for heating buildings and for other war plants which are short of fuel.

"It is time to get hard-boiled with people who habitually waste fuel. The war makes it impossible for us to go on using it in our normal, peacetime manner."

Classes of consumers affected by the order include apartment houses, hotels, department stores, theaters, office buildings, warehouses, factories, public institutions, schools, and other large users of fuel bought from retail dealers.

Construction Volume

Preliminary estimates of new construction volume in the United States in 1945, based on the assumption that war on both fronts will continue throughout the year, indicate an activity volume of $3,250,000,000, the WPB reported January 15.

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It is decoratively desirable—so inconspicuous as to be practically invisible.

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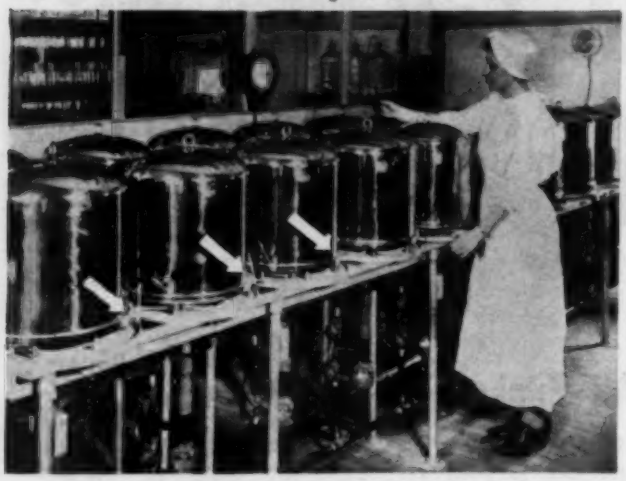

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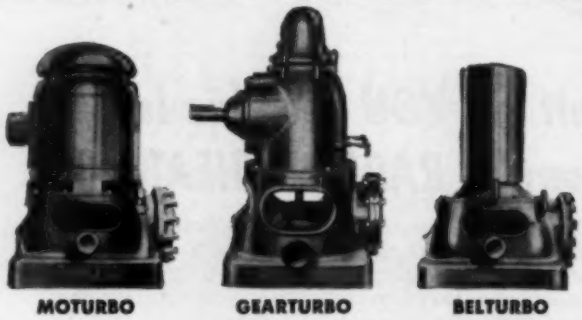

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This estimated activity is 82 per cent of the 1944 volume and 24 per cent of the peak 1942 performance. Almost half the 1945 volume will be accounted for by privately-financed work as contrasted to 40 per cent in 1944 and 20 per cent in 1942 and 1943, WPB said.

Construction activity generated by purely military requirements is expected to be about a third less in 1945 than in 1944, both for industrial and non-industrial work. Activity in the construction categories for essential civilian and indirect war purposes is expected to continue in 1945 at about the 1944 rate, with an estimated decline in new housing volume being offset by increased non-military work in the industrial field and other non-residential categories.

Conventions and Meetings

Organizations planning to hold conventions, conferences, trade shows, or group meetings after February 1 "will have to show how the war effort would suffer if the meetings were not held," Col. J. Monroe Johnson, chairman of the government's War Committee on Conventions, announced last month.

The committee has approved the form of application required of organizations planning group meetings to be attended by more than 50 persons. Information required by the committee includes:

Whether the planned meeting is a convention, conference, trade show, or government meeting; the date and location of the proposed meeting and name of hotels or other facilities that will be used; attendance planned; previous frequency of meetings; location and attendance of last previous meeting; average attendance at similar

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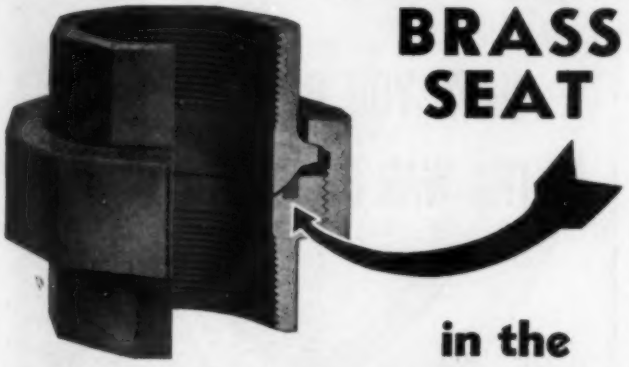
meetings before the war and during the war; from what area those attending are drawn; what steps have already been taken to curtail attendance; why the objectives of the meeting cannot be attained through "conventions by mail"; why a group of 50 or less to whom powers are delegated cannot transact the necessary affairs of the organization; and in what way and to what extent the war effort would suffer if meeting were not held.

Freon

Production of "Freon 12" (dichlorodifluoromethane) has been increased and stabilized sufficiently to permit a relaxation in restrictions on its use in refrigeration and air conditioning systems, the WPB said last month. An amendment to order M-28, dated January 29, provides that "Freon 12" may be used now for any refrigeration and air conditioning systems except those included in List A of the order.

List A includes amusement parks; animal hospitals; auditoriums; ballrooms, dancing studios and dance halls; bank and loan associations; bars, cocktail lounges, and beer parlors; bowling alleys; concert halls; funeral parlors; golf clubs, country clubs, athletic clubs, and all other clubs and club houses; hotels and apartment houses; moving picture houses; night clubs; office buildings and offices, public and private; railway, street car and bus stations and terminals; residential buildings and dwellings of all kinds; resturants, cafeterias, and other places selling meats, food or beverages; schools; service establishments such as laundries, cleaners and dyers, tailor shops, barber shops, beauty parlors, auto-

The RECESSED BRASS SEAT



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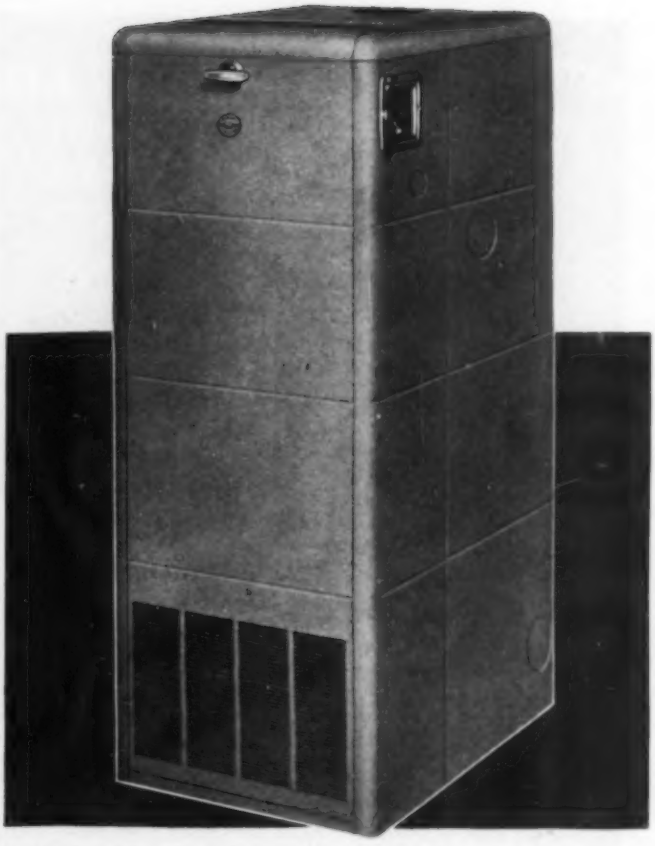
JEFFERSON UNION

is cut from seamless drawn tubing —free from all casting defects— sound and uniform always!

JEFFERSON UNION CO.

601 West 26th Street, New York 1, N. Y.

Factories at
Lexington 73, Mass. Lockport, N. Y.



Here's the New Type 10
MUELLER *Climatrol*
Gas Boiler

— restyled for better appearance
— redesigned for better performance

Included is an entirely new burner design which is extremely quiet in operation. Many other new features. A product of one of the pioneer manufacturers in the gas-heating field, this latest model has behind it an 88-year record of building boilers to quality standards that make installation easier and assure satisfactory performance. Write for bulletins on Climatrol gas boilers . . . *L. J. Mueller Furnace Co., 2007 West Oklahoma Avenue, Milwaukee 7, Wisconsin.*

Type 10 — Type 11

for residences and small commercial installations.

Type 10 has all controls and the backdraft diverter enclosed within the boiler jacket.

Type 11 has the diverter enclosed within the jacket, with controls exposed.

Type 20

for larger residences, apartments, stores, commercial and industrial buildings, etc.

Gas burner manifold and safety controls enclosed.

New wide range of sizes. Control equipment and trim interchangeable for either right-hand or left-hand end installation.

E 14

MUELLER *Climatrol*
Reg. U. S. Pat. Off.
GAS BOILERS AND
GAS-FIRED UNIT HEATERS

QUALITY always wins!
MARTOCELLO Products are fully DEPENDABLE

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and
CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co. 229-231 NORTH 13th STREET PHILADELPHIA 7, PA.

Serving the Ice Industry Since 1916 "There is no Substitute for MARTOCELLO QUALITY"

... Janette Blower Wheels

In the 18 years Janette Blower Wheels have been used by the leading manufacturers of coal stokers, oil burners, blowers, air conditioning units, generators, superchargers, dust collectors, hair dryers, air cooled engines and ventilating apparatus, **they have always been sold as a quality product.**

When a manufacturer wants to select a blower wheel, which will give quiet, trouble-free service year after year, **there is no other wheel superior to a Janette,** because of its patented construction.

May We Send Information?

Janette Manufacturing Company
556 W. Monroe St. Chicago 6, Ill.

mobile sales and service shops, and repair shops of all kinds; skating rinks; stores, selling any kind of products, material or merchandise, at retail or wholesale (excluding manufacturing establishments); studios of all kinds and theatres.

Previously, refrigerating and air conditioning systems not included in List A, such as those in food preservation establishments, industrial plants, aircraft plants, etc., could obtain "Freon 12," but only under certain specified operating conditions such as where an air cooled condenser is used and the ambient temperature is 110 F or higher, or where the system is used in a sealed railroad car or sealed bus. The effect of this provision was to force conversion of many essential systems to other refrigerants.

Fuel Oil

Harold L. Ickes, Petroleum Administrator for War, last month cautioned home heating oil users that stocks are below last year's level and that consumers should avoid excessive consumption that will deplete stocks too rapidly.

"For the remainder of the heating season, meeting home heating oil demands will be strictly touch-and-go. Fuel oil supplies are tight but adequate to meet current rationed demands," Administrator Ickes said.

"However, there is not as much fuel oil available this year as there was 12 months ago. That means that overconsumption will make the problem more critical. Furthermore, military requirements have been stepped up, placing a further burden on American refiners," he added.

HAVE YOU BOUGHT YOUR EXTRA WAR BOND THIS MONTH?

KEEP BUYING THEM UNTIL OUR BOYS COME HOME

Fuel Oil

To ease the tight fuel oil supply situation on the east coast, Petroleum Administrator for War Harold L. Ickes re-instituted January 17 a 10-day restriction on inventories held by industrial plants and other large scale consumers.

Action was taken by amending a formal order. The amendment in effect provides that consumers in the east coast states who use fuel oil in other than private dwellings may not accept delivery of additional fuel oil if their tanks already store a supply large enough to satisfy normal seasonal withdrawals during the ensuing 10-day period. The amendment does not affect fuel oil supplies in private dwellings, refineries, or bulk terminals. It permits public utilities to maintain a 30-day inventory.

Under the provisions of the new amendment, it is possible for a large fuel oil consumer to stock up on more than a 10-day supply only if the normal shipment to the consumer would increase his supply beyond that point. Thus, if a tank car is normally used to deliver fuel oil to a consumer, the consumer may accept delivery of the entire load, even though it increases the stored stock beyond a 10-day inventory. This provision is made to prevent inefficient use of transportation facilities.

Fuel Oil Ration Order

Amendment 41 to the OPA's revised ration order 11, rationing of fuel and fuel products, which amendment was effective January 24, makes clear that before any further deliveries may be made (even for ration evi-

HOW DIRTY ARE YOUR FILTERS?

THIS GAGE TELLS

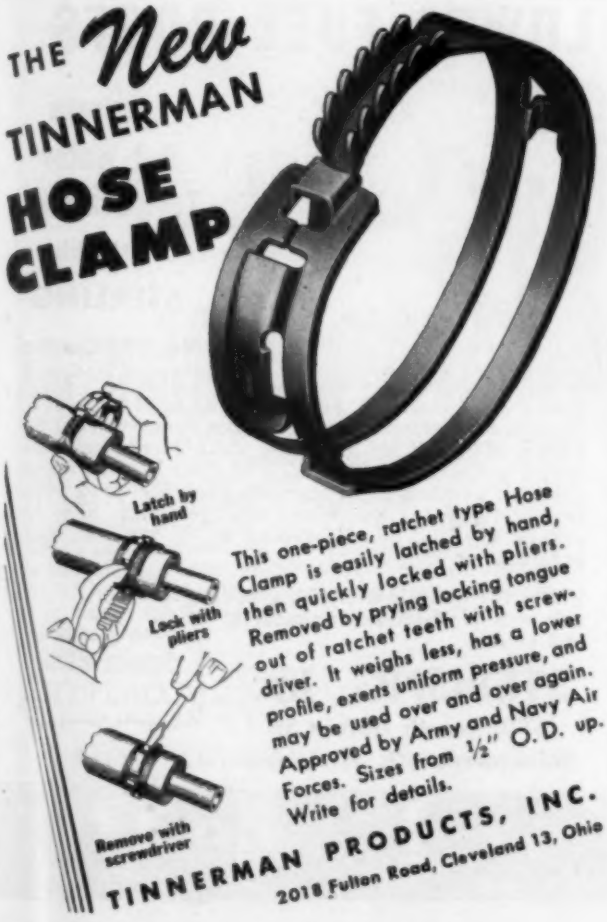
HAYS AIR-FILTER GAGE

- *Automatic*
- EASY TO INSTALL
- SAVES MONEY
- ELECTRICALLY OPERATED

If you are confronted with the problem of not knowing when the collected dirt in your filters is of sufficient density to decrease operating efficiency, install a HAYS Air-Filter Gage. The HAYS indicator shows amount of air resistance at all times—tells when to renew filter element—eliminates guess work—can be made to sound alarm when resistance is excessive. Write for full information. Ask for HAYS Bulletin A-F G.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROLS
MICHIGAN CITY, INDIANA, U.S.A.

THE *New* TINNERMAN HOSE CLAMP



This one-piece, ratchet type Hose Clamp is easily latched by hand, then quickly locked with pliers. Removed by prying locking tongue out of ratchet teeth with screwdriver. It weighs less, has a lower profile, exerts uniform pressure, and may be used over and over again. Approved by Army and Navy Air Forces. Sizes from ½" O.D. up. Write for details.

TINNERMAN PRODUCTS, INC.
2018 Fulton Road, Cleveland 13, Ohio

"GENERAL" MULTIBLADE EXHAUSTERS

Forward Curved Blades

A Full Line

Forward and Backward Curved Blades

All Drive Arrangements

Surprisingly Quick Deliveries

Write for the New "Blue Book" Bulletin SC-101

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AIR CONDITIONING NOZZLES

Nozzles of unique Yarway Involute Design.

No internal parts or vanes to clog or erode.

Insure trouble-free air washing service.

Sizes and types for all requirements.

Many large users—installations total more than 5 million gallons per minute in water cooling and air conditioning service. Write for Bulletin N-616.

YARNALL-WARING COMPANY
107 MERMAID AVENUE
PHILADELPHIA 18, PA.

YARWAY

dences paid on delivery) to a transferee delinquent for more than 15 days, the transferor must have filed the report specified in section 1394.5712 of the order.

Amendment 42, effective January 24, provides that a dealer who is operating with a smaller storage capacity than that originally registered shall give his local rationing board any resulting excess of ration currency.

Amendment 43, effective January 24, provides a revised procedure for establishing reserve inventories of fuel oil for industrial consumers.

Amendment 44, effective January 26, establishes new forms and procedures which should remove previous complexities in the application, processing, and issuance of rations for domestic cooking and lighting and for other miscellaneous purposes.

Amendment 45, effective February 2: Supply conditions make it necessary to cut off further applications for fuel oil rations for use in heating equipment reconverted to burn oil. The action withdraws the opportunity extended last November 4 to private householders and other small volume users in the east coast and midwest areas to reconvert to oil burning equipment if they had changed to the use of coal or wood after the first restrictions were placed on fuel oil. It does not affect consumers who have already reinstalled their oil burners under the previous provision, nor does it affect those who have received an advance ration for equipment now being reinstalled. The action, however, stops any further reconversions except for hardship cases. Individual householders and other small volume users will now be eligible for reconversion rations only if hardship can be established.

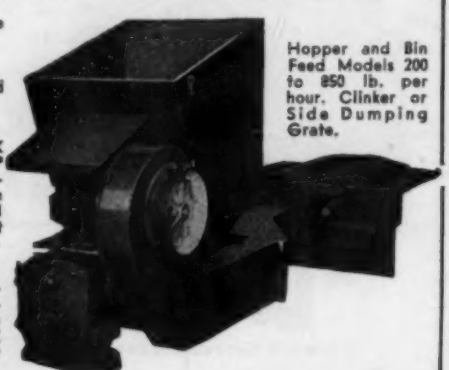
SOMEONE NEEDS THE COAL YOU WASTE

It is not only unpatriotic to use more coal than you need—and deprive others of necessary fuel—but wasted coal costs you money. It is a fact that FREDERICK Industrial Stokers have saved users hundreds of tons of coal in a single year.

√ The fully active grate surface
√ Continuous speed type transmission
√ Completely enclosed windboxes and mechanism

plus other FREDERICK engineered features,* give maximum combustion efficiency with minimum service and maintenance—and result in lowered fuel consumption.

*Our new Stoker catalog enumerates additional reasons why you should use FREDERICK Stokers. Send for it now . . . no obligation.



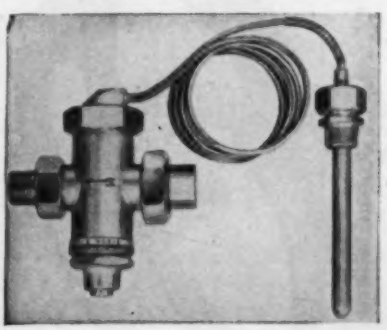
Hopper and Bin Feed Models 200 to 850 lb. per hour. Clinker or Side Dumping Grate.

ALSO KEEP IN MIND—For over 25 years FREDERICK has been making fine Centrifugal Pumps, guaranteed to meet the operating conditions for which they are sold. Write for full information.

THE Frederick IRON & STEEL CO.
Frederick, Maryland

STOKER SPECIALISTS SINCE 1918

LOWER FUEL COSTS



Accurate Hot Water Temperatures with this STERLING No. 150 Control

Control temperature automatically, conserve fuel and SAVE MONEY by installing the efficient, self-contained and self-operating STERLING No. 150 Series Control. Engineered to maintain accurately regulated temperatures for hot water storage tanks, heat exchangers, stills, etc. Pressures up to 125 lbs., temperatures to 250° F.

Write for bulletin No. 402. Consult your local jobber for catalog and prices.

Fuel-Saving Starts With CONTROL

STERLING, Inc.
3738 North Holton St.
Milwaukee 12, Wisconsin

Hotel Air Conditioning

The compliance division of the WPB issued last month a consent order barring a hotel in New York City from making any alteration or engaging in construction work over $100, until 1946. This penalty was ordered because the hotel violated WPB regulations when it installed an $18,000 air conditioning system, compliance division officials stated.

The hotel will be permitted to maintain and repair its structure and premises, but no blanket authorization or permission will be given for miscellaneous constructions until after December 31, 1945, compliance officials emphasized.

WPB charged the hotel with purchase and installation of an air conditioning system about February 1943, at an approximate cost of $18,000. This action violated WPB conservation order L-41, which prohibits installation of extensive air conditioning systems that would divert critical labor and materials, WPB said. Specific authorization and approval must be obtained for beginning such construction work, WPB officials explained.

Natural Gas

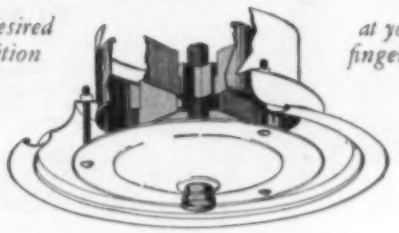
Edward Falck, director of the WPB's office of war utilities, issued February 2 an urgent appeal to all users of natural gas throughout the Appalachian area to reduce immediately their consumption of gas in order to avert complete breakdown of distribution facilities.

At the same time Mr. Falck announced that WPB has ordered the gas companies to curtail or completely eliminate, wherever possible, the use of gas in places of

KNO-DRAFT

PROVIDES MAXIMUM EFFICIENCY
THROUGH CONTROLLED AIR DIFFUSION

Any desired condition — *at your finger tip*



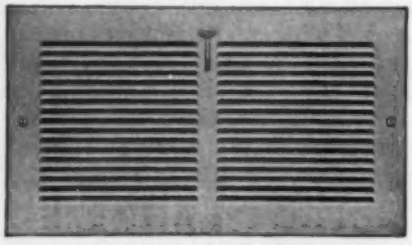
KNO-DRAFT *Type K Adjustable Air Diffuser with Type D Volume Damper.*
Patented

All Kno-Draft Air Diffusers are also equipped with *air direction* adjustment to suit seasonal or individual requirements. Their engineered design insures more effective room air mixing, more uniform room temperature and controlled, noiseless, draftless air diffusion at low cost.

Write for descriptive folder D.

W. B. CONNOR ENGINEERING CORP.

114 East 32nd St. — WB CONNOR — New York 16, N.Y.



No. 7032—AIRO-FLEX REGISTER

ADJUSTABLE

AIR DIRECTIONAL REGISTERS

This model is a simple, sturdy, moderate priced register suitable for most forced air heating jobs. Modern and pleasing in appearance, it has single louvre and bendable fins, set when delivered at about 22° downward. Furnished for wall and baseboard registers and intakes. It's an efficient, easily installed register, which does not run up the cost where the job must be kept within limits.

Auer offers a complete line of floor, base, and wall registers and return faces, for gravity or air conditioning systems—including all air directional types. We also make flat metal grilles. Ask for Auer Register Book—or special Grille Catalog "G."

THE AUER REGISTER CO., Cleveland, O.

AUER REGISTERS
& GRILLES · For Air Conditioning *and* Gravity

"COMMERCIAL"

VENTURI TYPE FAN HOUSINGS

A new line of 12 sizes are now available without die charges.

The venturi section and support plate are formed in one piece — without welds or folds.

This is the fan housing that will maintain full efficiency of the fan.

WRITE FOR PARTICULARS

THE COMMERCIAL SHEARING & STAMPING CO.
Youngstown, Ohio

SPEEDING THE WAR EFFORT of THESE BUSY PLANTS

"American"
COLD PIPE, CONDUIT and TUBE BENDING MACHINES

Bridge-builders, shipyards, engineering firms—busy with war work—depend on these machines! They'll speed peace-time conversion, too. *Twelve types:* hand operated capacities from ¼ to 6" inclusive; motor operated, ½ to 8" inclusive. *More than 12000 customers can testify to the dependability of "American's" 12 types of machines.*

A Few Of Our More Than 12,000 Customers: Bureau of Ships, Wash., D. C.; Henry J. Kaiser Co., Calif.; Pacific Bridge Co.; Bethlehem-Hingham Shipyards; Hercules Powder Co.; Stone & Webster; E. I. Du Pont de Nemours & Co.; Crane Co.

WRITE FOR PRINTED MATTER

"American" PIPE BENDING MACHINE Company INC.
Quick Deliveries
51 PEARL ST.
BOSTON, MASS.

EFFICIENT
ECONOMICAL

De Luxe type WK Pressure Actuated Water Regulating Valves for Freon, Sulphur or Methyl, are pilot operated, modulating. Standard adjustable opening range from 50 to 150 lbs. Factory set to open at 90 pounds. Precision engineering and individual testing for low cost, satisfactory performance. Available in sizes of ¾ to 2 inches FPT. Simple adjustment—easily serviced.

Other sizes and types are also available.

Electrimatic
2100 INDIANA AVE. CHICAGO 16, ILL.

amusement and in schools, museums, libraries, and other similar buildings.

Solid Fuels

The full wartime authority of the Solid Fuels Administration for War has been invoked to effect conservation and fair distribution of available supplies of solid fuels to meet emergencies in the wide area affected by the railroad freight embargo, Administrator Harold L. Ickes announced January 26.

The administrator also urged all users everywhere to conserve fuel as rigorously as possible, since bad weather and the lack of transportation are drastically and unavoidably limiting coal production.

Calling upon municipal officials in a specified area to cooperate in certifying to fuel dealers names of persons needing emergency fuel deliveries and to take action to curtail use of solid fuels in places of amusement and public and private institutions to the extent permitted by health, the administration took action to:

1) Forbid retail dealers and tidewater dock operators to deliver solid fuels to consumers having more than five days' supply on hand.

2) Permit deliveries of one ton or enough solid fuels to last seven days, whichever is larger, to consumers with five days' or less supply on hand.

3) Authorize mayors or other chief executives of municipalities to certify the names of consumers eligible for immediate fuel deliveries, and to cooperate otherwise with local SFA distribution committees in handling fuel emergencies. Mayors are authorized to work with dealers in establishing such committees when they are not already in existence.

4) Direct all SFA advisory committees on local distribution to meet with chief executives of municipalities within their area to arrange necessary emergency programs to assure the equitable distribution of solid fuels and avert extreme hardships.

5) Authorize SFA area managers, on recommendations of advisory committees or of retail dealers, where these committees do not exist, to relax the emergency limitation on deliveries where supplies permit.

6) Urge mayors or other chief executives of municipalities to exercise their full powers to make available public and private conveyances for emergency fuel deliveries and to obtain manpower to carry them out.

7) Urge these officials to do everything in their power to curtail or eliminate the use of solid fuels in places of amusement such as theaters, moving picture houses, bowling alleys, night clubs, and in libraries, museums, schools, and other buildings, both public and private, where curtailment can be effected without damage to health.

Tanks

Manufacturers of plumbing and heating tanks may produce only 25 per cent of their yearly quotas during any one calendar quarter, the WPB announced January 8. This action was taken because it was felt that the critical manpower situation necessitates keeping quarterly production at a minimum in order that manpower may be used in production of other essential equipment, WPB said. Previously, order L-199, plumbing and heating tanks, merely established a quota for

the calendar year. The amendment to L-199 also provides that manufacturers must file monthly reports on form WPB-3717.

Unit Heaters

Delivery of unit heaters for extended surface heating will be limited to orders with ratings of AA-2X or better during the 90 day period from January 16 to April 16, 1945, the WPB announced last month. There is no inventory of unit heaters at the present time and the lack of copper and steel during the third and fourth quarters of 1944 and the first quarter of 1945 makes it impossible to meet the demand, it was explained.

Order L-107, extended surface heating equipment, restricts sale of unit heaters to orders rated AA-5 or better. Direction I to that order suspends for the 90 day period the legal effect of ratings lower than AA-2X.

Water Heaters

The WPB last month amended its water heater order, L-185, to bring it in line with present policies. The amended order eliminates any reference to the percentage of base year production of electric water heaters that may be produced. By removing this percentage reference, production can be increased or decreased in accordance with approved programs without requiring changes in the order itself. Production is still rigidly controlled, however, by means of special authorizations from WPB and is programed according to the stated needs of claimant agencies.

Production of non-electric water heaters still is permitted for each manufacturer at a certain percentage

The Problem of Cooling Off a Hot-Headed Building . . . *doesn't bother Allen Engineers.*

We have yet to find a job where the plant engineer could not tell us the actual heat input used for process in a building suffering with the hot head. Knowing this data, a precise calculation is possible, showing the expected temperature difference that can be maintained in the building, as well as a figure showing the expected velocity of gravity flow due to temperature difference and height between inlets and outlets (commonly called stack effect).

With these figures as a base, it is only necessary to look in a price book and determine whether or not gravity equipment or fan equipment will be the least expensive over a period of time. Allen always follows this sound procedure. We are always ready to talk shop with you. *The Allen Corporation, 9751 Erwin Avenue, Detroit 13, Michigan.*

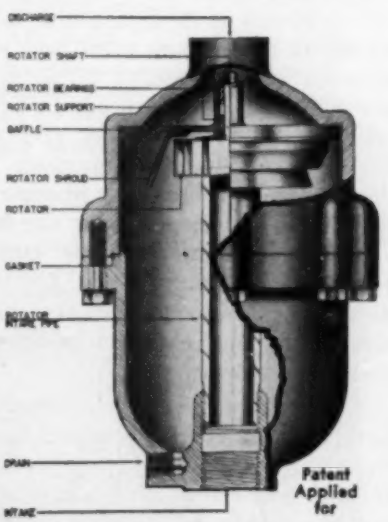
THE *Allen* CORPORATION

ENGINEERED VENTILATION FOR INDUSTRY

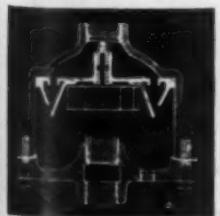
NEW TURBO-ROTOR *Pur-O-fier*

For Compressed Air

This new unit effectively eliminates moisture, oil and scale from compressed air lines. Pur-O-fier utilizes the principle of centrifugal force to separate entrainments from purified air. Once installed it requires absolutely no maintenance. Penstar Tru-Bond oiless bearing guarantees long, trouble-free operation. Manual or automatic drains provided.



Patent Applied for



Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

THREE MODELS AVAILABLE—A-1 will accommodate volumes from ½ to 5 cu. ft. A-2, volumes from 10 to 35 cu. ft. A-4, volumes from 35 to 100 cu. ft. Multiple units are recommended for volumes above this range. Pur-O-fier is the only standard unit that can be engineered to meet any air volume for regular or intermittent service.

BIRD-WHITE COMPANY
3120 West Lake Street, Chicago, Illinois
Dept. E.P.

Are Engineers Fussy?
"PUMPS by Aurora" Don't Mind

Every pump job is IMPORTANT. That's why we build ONLY fine pumps. The distinguished war record of Aurora Pumps is your assurance that post-war progress, too, will be aided by these superb performers.

Aurora Deep Well Turbines for all conditions—4" to 24"

Type AD Hor. Split Case, Two Stage Centrifugal

NSA Aurora Centrifugal Sump Pump

Type OD Hor. Split-Case Double Suction Single Stage Centrifugal

APCO TURBINE-TYPE PUMPS—the simplest of all pumps. Ideal for small capacity, high head duties. Silent, compact and lasting.

APCO Horizontal Condensation Return Unit

Type GMC Close-Coupled Centrifugal

Type GGU Side Suction Single Stage Centrifugal

APCO Single Stage Turbine-Type

Write for **CONDENSED CATALOG OR**

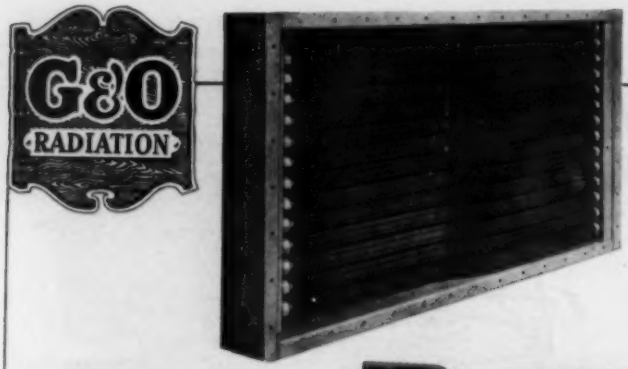
SEE OUR CATALOG IN SWEET'S

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

80 Loucks Street, AURORA, ILLINOIS



Detail of mechanical joint used in Universal Heat Transfer Coils.

G&O COILS

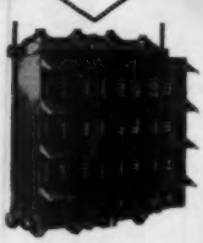
FOR HEATING AND COOLING IN A WIDE RANGE OF SIZES

Send for Catalog

THE G & O MANUFACTURING COMPANY
New Haven, Connecticut
Pioneer Manufacturers of Square Finned Tubing in the United States

WHEN YOU INSTALL UNIT HEATERS BE SURE THEY ARE TROUBLE AND MAINTENANCE FREE!

INSTALL GRID



Here is a unit heater that will stand wear as long as the pipes furnishing steam or hot water to it. In many installations this means GRID Unit Heaters will last as long as the building itself.

HERE'S WHY ..

★ One piece construction heating sections (patented) of high test cast iron that withstand steam pressures up to 250 lbs.

★ No soldered, brazed, welded or expanded connections to become loose or develop leaks.

★ No electrolysis to cause corrosion, breakdowns, leaks, or heating failures. It's the material that makes the difference in GRID Unit Heaters, so compare them with any unit heater on the market today. No other unit heaters have their lasting qualities. Complete information and capacity tables upon request.

HIGH TEST CAST IRON HEATING SECTIONS

D. J. MURRAY MANUFACTURING CO.
Wausau, Wisconsin

Also blast sections.

GRID

of his unit production of the same classification of water heater for his base year (1941), it was pointed out. Special authorizations from WPB are not required for this production. The amended order does specify, however, that manufacturers of non-electric water heaters may produce only 25 per cent of their yearly quotas during any one calendar quarter. This action was taken because it was felt that the critical manpower situation necessitates keeping quarterly production at a minimum in order that manpower may be used in production of other essential equipment, WPB said.

The amended order also provides that applications from manufacturers who have not previously produced water heaters will be accepted and processed on the same basis as all other applications.

General Chemistry

Engineers engaged in specific problems of technology may become so engrossed in the specific applications of chemistry as to be unaware of the rather extensive changes that have occurred in the teaching of classical chemistry, if not to classical chemistry itself. It is startling just to run through the chapter headings of this new text* on general chemistry, for there seems to be so little that ties up with memory's concept of what we used to study as chemistry, and so much of what we hear talked of every day. To a large extent, chemistry and physics seem to have become merged into a single science. To mention but a few of the topics that seemed heretofore to belong to the realm of physics, the subjects properties of gases, liquefaction of gases, subatomic particles, and atomic structure, will be found among the chapter headings of this new book.

Professor Timm has made a fine attempt to set down the tremendous advances made by chemical science from the viewpoint of fundamental principles, although as he admits in his preface, a textbook must be a compromise between what the author thinks is good for the student and what the student needs to hold his interest in the course. But the book does give a thorough review of the basic concepts that engineers find extremely useful daily in their technology, whether it be corrosion, ionization, the atmosphere, or the laws of solutions. A complete description of the book can hardly be attempted in a short review, for it has 692 pages and 45 chapters. Among them are chapters on metallurgy, electrolysis and electrometallurgy, metals and alloys, and hydrocarbons.

The style of the book is especially noteworthy; the author writes for his students as though he were conversing with them in his classroom. The result is a lucidity and clarity that make for easy and enjoyable reading, and quick comprehension of the context.—*K.S.*

*General Chemistry, by John Arrend Timm, professor of chemistry and director of school of science, Simmons College. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. $3.75.

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MEETINGS & CONVENTIONS

Note—These meetings were originally announced before issuance of the government request for cancellation of national conventions after February 1, so that it is to be expected that some or all of them will either not be held or will be restricted in attendance to a maximum of 50 persons. Col. J. Monroe Johnson, ODT director and chairman of the War Committee on Conventions, said February 1 that the chances of approval of any non-local meeting of more than 50 persons are "extremely slim."

American Society for Testing Materials

After consultation with the government's War Committee on Conventions, the American Society for Testing Materials canceled ASTM committee week which had been planned for Pittsburgh, Pa., during the week of February 26—and the spring meeting of the society, scheduled for February 28, is being postponed. While much of the committee work deals with production problems involving specifying and testing of war materials, committee week would have brought together several hundred persons in one place in a period of three or four days and the government feels that this is most inadvisable in the present transportation emergency.

War Production Conference

The third annual war production conference sponsored by the Chicago Technical Societies Council, Thursday, March 29, Stevens Hotel, Chicago. A panel session on heating and air conditioning, sponsored by the Illinois chapter of the American Society of Heating and Ventilating Engineers, is on the program. Publication office of the CTSC is at 75 E. Wacker Dr., Chicago 1, Ill.

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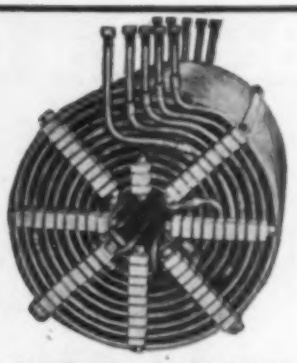

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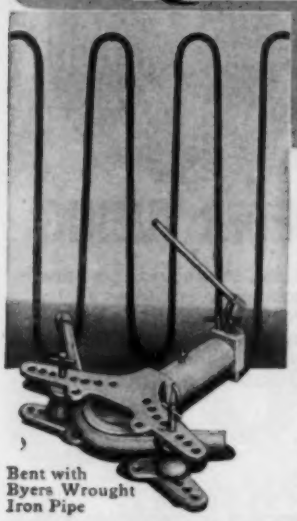

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Products of Tomorrow

First National "Products of Tomorrow" Exposition, to open approximately March 1, Chicago Coliseum. The general manager is Marcus W. Hinson, Chicago Coliseum 1513 S. Wabash Ave., Chicago, Ill.

Midwest Power Conference

Midwest Power Conference, eighth annual meeting, April 9-10, Palmer House, Chicago. Application has been made to the war committee on conventions to hold this conference. Among the subjects programmed are reverse cycle heating, by Philip Sporn, American Gas and Electric Service Corp.; radiant heating, by T. Napier Adlam, Sarco Co.; energy sources of tomorrow, by Ralph A. Sherman, Battelle Memorial Institute; water conditioning, by Leo F. Collins, Detroit Edison Co.; centrifugal compressors, by W. H. Carrier, Carrier Corp.; and cooling tower performance, by J. Lichtenstein, Foster Wheeler Corp. Prof. S. E. Winston, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill., is the conference director.

Foundrymen's Meeting

American Foundrymen's Association, 49th annual meeting, which was scheduled for the week of April 30-May 4 in Detroit, has been cancelled, according to an announcement by the association's board of directors. The headquarters office of the AFA is at 222 W. Adams St., Chicago 6, Ill.

Copper and Brass Association

In view of the transportation and hotel situation which has led the ODT to restrict meetings and conventions, the board of directors of the Copper and Brass Research Association has voted to abandon the 25th annual meeting of the association due to be held on May 17. Election of officers, approval of the budget, and other important questions will be acted upon by mail.

District Heating

National District Heating Association, 36th annual meeting, Deshler-Wallick Hotel, Columbus, Ohio, to be held late in May or early in June. John F. Collins, Jr., 827 N. Euclid Ave., Pittsburgh 6, Pa., is secretary of the NDHA.

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